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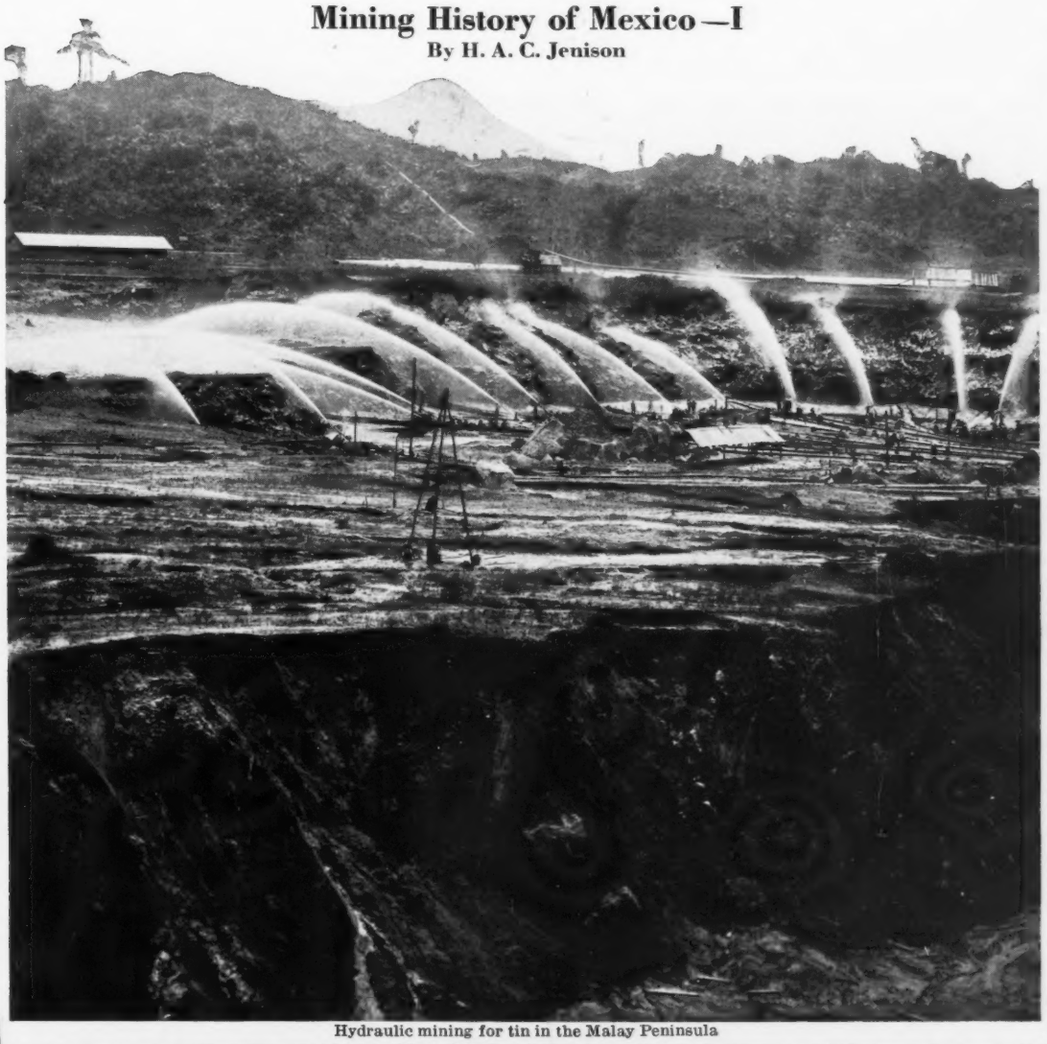

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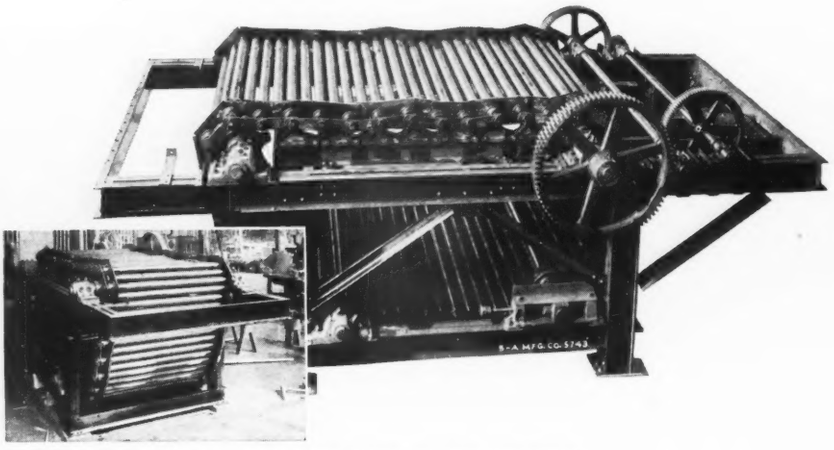
February 24, 1923



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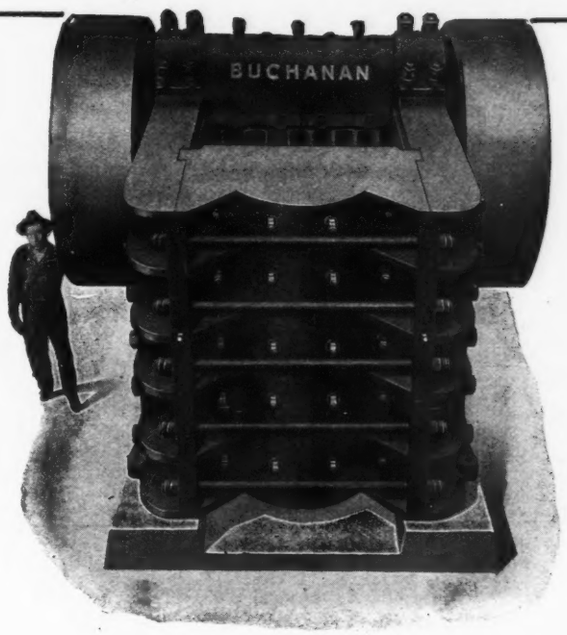

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 115 | New York, February 24, 1923 | *Number* 8

The Beginning of the End

A LARGE CUSTOM SMELTER announces that after April 1 it cannot guarantee that domestic shippers will receive $1 per ounce for their silver. This notice, although anticipated, appears much earlier than expected. Evidently no chance is being taken that Senator Pittman's optimistic prediction, that silver will not again go below a dollar an ounce, may be fulfilled. It is to be noted that the smelter especially uses the word "guarantee," which means that it will doubtless pay the dollar price so long as it receives the equivalent from the Treasury, but as it generally takes several months for the metallic products to be extracted from an ore and refined, and inasmuch as there will likely be a grand sprint to rush the very last ounce of silver to the mint under the gong, the smelter must naturally have some protection.

The present notice is more a warning than a formal note of "finis" to the Pittman Act. Where smelters also mine, smelt, and refine their own ore, an opportunity will be given to favor their production to the disadvantage of the shippers'. The customers of the smelter will have to rely on the sense of fairness and square dealing of the smelters for a proper return on their shipments. After the rush is over and the smoke has cleared away they will be able to judge the treatment accorded them. As the miners and smelters are required to submit affidavits at the mint testifying to the domestic origin of the silver they wish to sell at one dollar an ounce, the small shipper is assured of receiving that price for all of his metal accepted by the Treasury. The affidavits are a matter of public record.

Blue Skies and Cold Decks

OF 1,000 GOOD AMERICANS, probably 999 want to get rich quickly—if they are already rich, they want to get richer. And of these, at least 995 are ready to risk $50 or $500, or $50,000, as the case may be, on a "long shot." It seems to be in the blood. If you called it "gambling" many of them would feel grievously affronted. Investment, speculation perhaps, but gambling—never! It seems not to occur to them that the promised winnings of hundreds or even thousands per centum is really the inducement that makes them part with their money. At any rate, the desire to take a chance burns in most all of us; and we have ourselves to blame for the unscrupulous promoter, who does his best to keep the supply up to demand. Mining, for obvious reasons, offers excellent material for his operations. Superficial examination often fails to reveal the crooked features of a fraudulent proposition; and, since the dishonest promoter is generally a more plausible talker and more artful salesman, he is often successful where the honest man fails. It is the activity of the faker that has made legislators feel the necessity for putting "blue-sky" laws on the statute books.

About thirty states already have restrictive regulatory laws, and the Colorado Legislature is expected to pass a "blue-sky" bill during the present session. This bill has been drawn under the guidance of the Colorado Metal Mining Association, and the passage of it is being advocated by the mining interests of the state. It differs from most "blue-sky" laws in that no commission is set up to pass on the merit of any enterprise, as a prerequisite to offering stock for sale to the public. It is contended by opponents of "blue-sky" legislation who are interested in the mining industry that the average law is a serious and unfair obstacle to the financing of legitimate small-scale mine operations, and that in consequence the development of prospects and of the mineral resources of the country is retarded in an unwarranted way. It is certainly true that the appraisal of a prospect, or the determination of how good the chances of success may be, is a difficult task even for the most experienced engineer or geologist, and much more so for some state official who is probably selected for political reasons. Moreover, the delegation to some appointee or small commission of authority to turn "thumbs down"—or up—on any offering of stock involves opportunity for official fraud and graft.

The Colorado plan, we understand, aims only to make the promoter come out in the open and go on record with a sworn statement as to just what are the details of his proposition and just how he intends to finance the company. He must give details regarding promotion stock, and state how much money he will put into the mine and how much he will put as "commission" into his own pocket. These facts are filed and become part of the public record. A new statement must be filed every six months. The record is the basis for prosecution in the case of fraud or misrepresentation. A clever stock salesman can fill his victim full of all kinds of verbal bunk when he is trying to close a sale. He will be much more careful about the statements which he makes in writing under oath. If the "customer" has not the good sense to ask for a copy of the sworn statements on file at the State House, and to mull over it at his leisure, he should expect little sympathy if he is swindled. If the law demands enough detailed information, and if it provides adequate penalties for violation, it ought to be effective.

Whenever a man starts sinking a hole on an outcrop of ore he is gambling with nature; he is taking a chance. We believe that he ought to be able to share his gamble with others, who, knowing exactly what the conditions are, desire to put their money into the venture. The man who wants money to dig for ore is not dangerous. The crook, on the other hand, has no interest in the mine except as a convenient framework on which to drape his stock-selling oratory; to him money spent to open a hole in the ground is a necessary expense incidental to the business of selling stock.

A badly drawn or badly administered "blue-sky" law is likely to prevent the financing of legitimate and honest undertakings. We are inclined to think, however, that it is possible to make a workable and efficient

"blue-sky" law. Those who oppose all such legislation on general principles complain that it tends to prevent a man from taking an "honest chance" in the great card game of life. On the contrary, a well-conceived law gives him just that—an *honest chance*. It bars from the game the sure-thing man, the promoter who knows before he starts that his victim has no chance in the world, the cheat who deliberately plays the game with a cold deck.

Concerning Scree

A RECENT BRITISH TEXTBOOK of geology makes one of the principal divisions of sedimentary rocks, scree deposits. Refuge to the dictionary shows that scree is really a word, although marked "Prov.," meaning provincial; and defines it as the same as talus. The word talus, however, apparently does not occur in the book; while it is doubtful if the word scree can be found in any American textbook of geology. Talus is a Latin word; the dictionary derives scree from the Icelandic, but we suspect it is, rather, old English, and possibly a souvenir of the Danish occupation of England.

The instance illustrates the difference in vocabulary between England and America. Those who are working for a universal language, such as Esperanto, would do well to begin more humbly, and address themselves to the problem of the standardization of English, as spoken throughout the world. Recently, newspapers state, interpreters have been provided for Yankee tourists in London, so that mutual intercourse and swift understanding between them and those whom they encounter may be facilitated.

Americans are not altogether averse to absorbing additional vocabulary. They have semi-assimilated—but never completely—topcoat, trousers, and haberdasher. The old-fashioned American spoke in Anglo Saxon of breeches, and clung to pantaloons, which he telescoped into pants, a word frowned upon by American colleges and polite society, and marked "Colloquial" in the dictionary, but nevertheless, if the truth must out, an ineradicable Americanism. Many Americanisms are of ancient origin, found in the English of Shakespeare and the Bible, but not current in modern England. Shakespearian, for example, is the favorite "guessing" of America. Such words persist in rural communities, but are supplanted by newer and smarter terms in the great cities. The standard British English is a certain class of the urban speech; in the country the dialects are varied and bizarre. There are some English who speak like some Americans, and who pass in America without strangeness; and there are Americans who speak sufficiently like the English to be difficult to place. But there are the common extreme types, apart from dialects—the strident, nasal American, who jars on all sensitive ears of whatever country; and the Britisher with the sing-song intonation and that mouthing of words which Booth Tarkington called a "precious" pronunciation.

At least, however, a common scientific vocabulary might be arranged. During the war, the mineral experts in Washington discussed the tungsten problem with their British colleagues, who called it wolfram. Both, of course, were orthodox, but a would-be buyer or seller of wolfram endeavoring to operate in the New York market would be likely to meet with linguistic obstacles.

The Trade Association in the Non-Metallics

MANY OPERATORS in the mining industries have been forced to the conclusion that the prosperity if not the very existence of their occupation is dependent upon united protective action through the offices of a trade association. Primarily some associations were organized for the purpose of fixing prices, limiting production, stifling competition, or otherwise forcing a deluded public to pay undeserved profits. Fortunately, this dominantly selfish motive has been leavened by better impulses, and the trade association of today is gradually assuming the rôle of an investigator and inventor whose function is to win public confidence by developing a high standard of perfection in products and in methods of sale. In a way this step has been forced upon the trade association, for industry has been made to realize that the public is constantly becoming better informed regarding commodities, that competitors are ever ready to give wide publicity to flaws in products or in methods of salesmanship, and that any questionable activities will sooner or later be brought to light, with consequent injury to reputation. Without attempting to analyze in detail the conditions which have influenced the trend of trade associations, it is reassuring to note the growing tendency toward improvement of product and elevation of ethical standards in American business practice.

At the present stage of human development healthy competition is one of the keenest incentives for the invention of new products and processes, and for the development of a high degree of perfection in organization and workmanship. Progressive companies under the spur of competition have developed many new products that have contributed greatly to human comfort and happiness. The trade association tends to transfer this element of competition from the individual to the group. This obviates much duplication of effort, and enlists the best intelligence of an entire industry in a united endeavor that is far more effective than the scattered activities of individual companies each working alone. Thus, some trade associations of the higher type have developed into research institutions, with highly trained technical men in their employ, devoting their entire time to working out problems in manufacture or utilization. Others maintain co-operation with outside research laboratories. The Fabricated Production Department of the Chamber of Commerce of the United States has made the statement that between sixty-five and seventy trade associations in the country are now conducting research as one of their important functions.

The trade association idea has developed rapidly during recent years in the group of the non-metallic minerals. At least twenty trade associations of national scope are now organized in this branch of mining or primary manufacture, and a still greater number of local associations exists. Prominent in the former group are such organizations as the National Lime Association and the Portland Cement Association, both of which are active in finding wider uses, and in working out problems of utilization whereby the consuming public may use the products of the industries which they represent more intelligently and economically.

Some of the more recently established organizations are just feeling their way in research. The idea is new, and operators are in doubt as to what lines of activity should be followed. There is a notable lack of information on what is already known, what sources of informa-

tion are available, and what agencies are now in existence with which co-operation may be established. The National Crushed Stone Association, at its recent convention in Chicago, took steps to launch a $15,000 per year research program. The committee on research of the association, assisted by a specialist from Ohio State University, devoted a year's study to the problem, and recommended the establishment of an informational service, with the gradual addition of specific problems, such as new uses and waste utilization.

Although the recently organized National Slate Association has no definite research plan at present, one of its aims is to develop investigational work in the future. It is desirable that the non-metallic mineral trade associations, particularly those that are just beginning research activities, should maintain close co-operation with the larger universities and also with such government bureaus as the Geological Survey, the Bureau of Public Roads, the Bureau of Mines, and the Bureau of Standards, where research work is long established, for their specialists, through years of experience, can render assistance of inestimable value.

The trade association not only fosters improvement in products, processes, and utilization, but tends also to improve fundamental conditions in the industries. One important function is the establishment of uniform cost-accounting systems. Drastic price cutting, with consequent demoralization of trade, has in some instances resulted from such poor bookkeeping that operators unknowingly sold at a loss. A carefully worked out, efficient and simple cost system is an important factor in the stabilization of prices and a most important assistance in promoting successful management.

The solution of transportation problems also demands united action. Many of the non-metallics are low-priced commodities per ton, and transportation charges are relatively high. In some instances the haulage charge exceeds the total of all other costs. The combined effort of many operators is much more effective than individual action in securing equitable commodity rates, improved car distribution, and uniform standards of packing, crating or boxing. Improvement in classification of products and the simplification of grades and types are important recent movements made possible only by concerted action.

In most discussions of trade association work there is a tendency to overemphasize the purely material benefits that accrue to the membership. From the broader viewpoint of industrial stability, and efficient service to the consuming public, the most important functions of the trade assication are the establishment of more cordial relations between individual companies, and the elevation of ethical standards in all business transactions. In general, the standards established by the non-metallic mineral trade associations indicate a strong tendency toward discouraging misrepresentation of products, rectifying improper and misleading classification, and promoting public confidence in educating the consumer in proper buying and economical utilization. The National Slate Association at its recent New York convention adopted as part of its code of ethics a resolution "to follow sound ethical principles in the conduct of our business, and to put every transaction on the very highest plane of business honor." Other similar organizations would do well to emulate this example, for, after all, integrity is the foundation stone on which all permanent progress in industry must be built and on which it must endure.

The Thirst for Geological Knowledge

CORRESPONDENCE with our readers, which is constantly going on, indicates that one of the principal demands is for a better exposition and comprehension of geology. This is a natural symptom. Mining methods and metallurgy are constantly developing, and engineers keep in close touch with their progress. As the curve of discovery of new ore deposits flattens, however, the need for a more scientifically managed supply of the raw material impresses itself as a matter of prime importance; and engineers are eager to be informed as to whatever is known on the subject. There has thus arisen a strong and increasing body of mining engineers who specialize on geology and who are continually advancing the science and the industry. Lately this group has organized as the Society of Economic Geologists, a world or international society, with headquarters in New York. In the Southwest, the Association of Petroleum Geologists has a large and enthusiastic membership.

How can the body of mining engineers be kept informed as to the progress of thought? Such sound principles and promising hypotheses as the specialists work out should not be guarded from general knowledge: on the contrary, it is in the fire of general discussion and practical test that such principles are most readily approved or discarded. Operating mining engineers rarely cling long to any fallacious explanation of ore occurrence; the perpetuation of such scientific delusion is more often at the door of the academic non-experimental investigator. Indeed, operating mining engineers have in many cases first detected fundamental principles in the science of ore deposition, and thus given forth sparks, which in contact with the inflammable substance of some trained geologist's intellect, burst forth into a proclamation of a new law which attracted general attention, and of course cast more glory on the annunciator than on the original detector. It is not so much the writer of the score, as the band master, who moves the crowd to admiration.

The journal *Economic Geology*, founded many years ago and published at New Haven, is a semi-quarterly publication which has a world-wide circulation and has for years upheld the highest standards in the publication of essays on mining geology. Engineers who are interested in the science should subscribe for it.

On our part, we shall do what we can to interpret the science and its progress to our readers. We have done something of that in the past; but there has been an insistent and accumulating plea that we have not done enough.

The Double Cross

F. P. A. writes in the *New York World*:

"A terrific honor is about to be given to Freddie. He is up for membership in the National Geographic Society. 'True,' he says, 'the Board of Directors have not formally passed on my name yet, but it looks as good as fixed, for the Secretary sent me a copy of the December *National Geographic Magazine* with his compliments, a sure sign of impending election, so people high up in the organization have told me.

"'I need the National Georgraphic Society badly to round out the last paragraph of my write-up for Who's Who in Norwalk, Conn. It will go like this: (Member of the New York Zoological Society could have been a *founder*), Red Cross, 1913—, Y. M. C. A. (Harlem Branch), Norwalk C. C., Audubon Society and National Geographic Society.'

"First thing you know Freddie'll be a notary public, too."

Concerning Defective English

By T. A. Rickard

THE 'Good Speech' weeks established by cities, and other similar efforts to arouse concern in correct speaking and writing, indicate an awakening of interest in a matter that is well worthy of public attention. What is the cause—it may be asked—of the ill use of our language, more particularly among those who, it may be presumed, are fairly well educated. In the first place it is one of the minor penalties we pay for the major advantages of our democratic system. In the old world the well-educated maintain a certain measure of aloofness from the uneducated, so that the writing and speaking of good English is an evidence of class distinction. The children of the one class do not go to the same schools as do those of the other class. The children of lawyers or engineers do not sit alongside the children of plumbers or plasterers. In our country the children of all go to the same schools. The consequence is that the American plumber's children speak much better English than is spoken by the British plumber's children; but, on the other hand, the children of an American professional man suffer from the unconscious imitation that is one of the traits we humans are supposed to have inherited from our simian ancestors. The broad result is that the English now written and spoken by the large majority of our population is being leveled up whereas that of the small minority is being leveled down. No democrat need repine at the result, but he may hope that eventually the leveling process may be followed by a general betterment. Next comes a logical extension of the process of deterioration in consequence of the influence of the common notion that it is an affectation to speak or write with care. Our men students regard niceness of speech as effeminate and our young engineers think that they give themselves a 'practical' air if they speak somewhat after the fashion of the workmen with whom they are associated in their technical operations. It is deemed practical and democratic to talk like a working miner; it is thought an affectation to assume the correctness of speech that is the mark of a gentleman of the old school. If I exaggerate, it is only to emphasize a contrast.

As children we, of the older generation of professional men, read the Bible; it was regarded as a necessary and inevitable part of our education; we became familiar with the beautiful language of that well of English undefiled. Today our sons read the cheap magazines; they do not read the serious articles, but they delight in the stories, chiefly of violence and crime, or of broad humor, written in the slang of the day. When they read tales told throughout in the colloquial language of the street they think they are reading English, whereas much of it is an ephemeral jargon, which will be as little understandable five years hence as it would have been understood five years ago. The language of 'Jimmie Fadden' is now almost archaic; that of O. Henry will soon be difficult to follow; and, ere long, let us hope, Irvin Cobb's slob English will be in the discard. Our young people wallow in this un-English, and then wonder why they lose both their taste for good writing and their ability to write well. When a force manifests motion in a given direction it can not be destroyed; if it fails to produce action, it will produce reaction. Next we have the influence of the daily newspaper, not so much that of the editorials as of the ordinary reporter's account of current events, in which the flapdoodle of the sophomore is rampant. The ordinary reporter's description of an event is beyond and beneath contempt, because it is no part of his trade—it can not be honored by the term 'profession'—either to state facts accurately or to comment upon them carefully. His aim is to be sensational at any cost, of truth or of art. Our young people—girls as well as boys—go to college for two or three years and receive some measure of instruction in the English language, and then they associate mentally for thirty or forty years with the garbage-collectors and the street-sweepers of a debased form of literature. Many of their instructors at college think it proper to teach good Latin and good history in bad English, and it is only recently that in our best universities it has become a rule to exact from the student the proper use of English in all examination papers. The greatest stumbling-block to effective teaching is the fact that teachers and students alike are not sufficiently familiar with their mother tongue—with the medium through which instruction is conveyed and received. It is absurd to teach Latin to a boy or girl that does not know his or her own language.

Another fruitful cause of bad writing is the example set by men of great distinction in the public life of the nation. Some of these gentlemen, who are rated as statesmen of high rank, write abominably; and because they are men otherwise admirable, their way of writing is bound, unfortunately, to impress young people. They are prone particularly to the use of abstract phrases, which are by way of being grandiose, and possibly mysterious. They are fond of words of many syllables, especially those ending in 'ion; they bespatter their utterances with 'co-ordination', 'co-operation', 'systematization', 'visualization', 'rehabilitation', and the like. They talk, as Roosevelt said, more like the imitators of a Byzantine logothete than like good earnest men. Such examples exercise a profound influence on the youth of the country, for to imitate those whom we admire is as natural as it is to avoid imitating those for whom we have no respect. It is a pathetic delusion to suppose that it is either American or democratic to be careless in speech; in due time the supposition will be recognized as an aberration worthy of humorous treatment. It is manifestly absurd that an engineer, who is accustomed to the proper use of instruments of precision, should use one of his most important implements—language—with the carelessness of a small boy with a pop-gun. It is ridiculous to teach a student correct history in incorrect language, or to endow universities to educate youth for a few years and then support newspapers that de-educate them during the remainder of their lives. These anomalies and contradictions are being appreciated, and in time they will be corrected. One thing we ought to take to heart: an American democrat should speak and write as well as a European aristocrat, because the chief difference between the American and the European is that the average American is the more intelligent, because he has a larger opportunity to become intelligent. Therefore let him show his intelligence by endeavoring to communicate his ideas with an ease and effectiveness that will fulfil the purpose of language.

DISCUSSION

World Oil Problems

THE EDITOR:

Sir—It is encouraging to see a man of the standing of A. C. Veatch laying the "fallacious bogy of imminent exhaustion of the oil supply of the United States" as he characterizes it, in "World Oil Problems," excerpted in your issue of Dec. 23. It seems to me that such pessimistic predictions can be made only without a consideration of such progress along practical and scientific lines as experience teaches to expect.

In the oil industry itself advance is to be looked for in both the geological and operating departments. It is scarcely more than a year since the latter has taken favorably to core drilling, but since it has done so it has opened up vistas to the former of which the geologist had scarcely dreamed. The geologist has now gone beyond the realm of paleontology, as he has used it in the past, and is now delving into micro-paleontology, identifying such minute organisms as diatoms and foraminifers brought up by the cores. I recently had a most interesting demonstration of a correlation accomplished in this manner and which was not possible by any other. This one advance alone bids fair to afford notable increase in production and a saving in drilling.

Meantime the operator is not standing still. Experiments and researches are going on continually, from which we have reason to look for cheaper drilling, greater recovery, and more economical handling. With these we may then go deeper and reach sands that are now below the economic limit.

Mr. Veatch says, "The oil in the sedimentary rocks of the United States is by no means exhausted." Interesting confirmation of this statement is found in the record of three California fields, Huntington Beach, Long Beach, and Santa Fe Springs, the oldest of which was brought in in May, 1920. With a combined production period to Jan. 1 of sixty-three months, these fields, all small in area, have yielded 44,000,000 bbl. But the significant feature is that every one of them is within 20 miles of the largest city west of the Mississippi River and one inside the corporate limits of a city of 80,000 population. Every foot of every one of them was known for three-quarters of a century before its oil possibilities were even imagined.

With such examples as this, who can say how many fields we are walking and driving over today which are simply awaiting intelligent exploration? As development continues and more wells are logged our knowledge of a locality is increased and we are enabled to draw conclusions with an intelligence not possible from surface study alone. Thus the development of one field not only adds to our oil supply, but furnishes us with information to assist in the search for other fields.

So much for the oil industry itself. But there are other industries at work providing substitutes for oil produced from wells. One of the most important of these will be shale oil. It is true that so far the problem of utilizing the great deposits of oil shale that have been found is still unsolved, but unquestionably it will be solved, and when it is, our supply of oil will be augmented in a degree literally immeasurable.

Experiments with the low-grade coals of the West show that they can be used at the pit mouth for the generation of electric power at a price which will be comparable with that hydraulically generated. This will be done by making producer gas, and one of the byproducts of the process is petroleum.

The wonderful strides in hydro-electric development will furnish a power not only for our industries and our railroads, but for cooking and for heating our homes, which will supplant oil and gas made from oil.

The day is not so far distant when we shall run our automobiles with the distillate of the waste of our lumber and sugar mills, perhaps in an internal-combustion engine or as fuel under the boiler of a steam-driven automobile, which will come into its own when certain basic patents expire.

These few suggestions, hastily sketched, touch only the high spots of the many favorable possibilities of the situation. Of course, nothing justifies waste or uneconomic production, but I must confess that I am not able to lose any sleep over the chance of my living to see a serious exhaustion of our liquid fuel resources. And if any of my mild predictions as to development seem far-fetched, ask your father or your grandfather what he would have thought fifty years ago had anyone told him that he would see the day when he would touch a button in the wall and flood the room with light, and that that light would come from a mountain torrent three hundred miles away.

LEROY A. PALMER.

San Francisco, Calif.

Wanted: Information on Bauxite Cement

THE EDITOR:

Sir—In reference to the article published in your issue of Nov. 4, 1922, by Raymond B. Ladoo, I would like to add the following:

Dalmatia, formerly a province of Austria and now in Jugoslavia, produced and exported during 1921 51,000 metric tons of bauxite. Of this 30,708 tons was shipped from the Dalmatian port of Sibenik, the rest from northern Dalmatia. All the bauxite was exported to Germany except 3,500 tons, which went to Philadelphia to the Republic Manufacturing & Mining Co., Inc.

The average analysis of Dalmatian bauxite shipped was as follows: Al_2O_3, 56.36 per cent; Fe_2O_3, 22.01 per cent; SiO_2, 0.85 per cent; TiO_2, 2.92 per cent; H_2O, 17.87 per cent.

The most significant fact is the low average of silica, which German manufacturers appreciate, in view of the high cost of soda in Germany, and they pay a premium of 25c. per unit of silica below 3 per cent.

I would appreciate it if you would publish this in your columns, and voice my request for more details from some expert on bauxite cement and drying and calcining, which as yet has not been introduced in Dalmatia.

Sibenik, Dalmatia. TONKO L. MILIC.

Tariff Gospel According to Marc

THE EDITOR:

Sir—In your interesting Fifty-fourth Annual Review there is a contribution from Marc Pawl, entitled "The Tariff on Minerals." This is his second argument against the tariff, and this time he completely flabbergasts the reader. My! my! Truly the gospel according to Marc is hard to believe.

In reading his philippic against the tungsten tariff one is forced to conclude there is only one capitalist in the United States who had the privilege of buying tungsten ore before the tariff and holding it for a rise after the duty was effective; that also this capitalist had the inside information from Congress and knew that the tariff was going to be levied, and took no chance whatever on taking a loss.

This closely resembles Edwin Lefevre's articles in the *Saturday Evening Post* on the stock market, and Larry Livington's manipulations. Lefevre goes into details about the inside workings. Marc Pawl tells the reader he had all the inside of just what the capitalist was doing and all about it, but leaves the details for the reader to imagine.

It would have been a little less partisan of Marc if he had said that it was anybody's privilege to buy tungsten at $2 a unit and make a profit that this capitalist did, but apparently that was not possible under Marc's system of logic.

Then we read on about antimony. Oh, dear! Oh, dear! We cannot square Marc's statements with the facts as published in Document No. 393, entitled "Tariff Act of 1922, H. R. 7456, Printed Sept. 20th, 1922." Marc states that antimony oxide is on the free list. We read on p. 2, paragraph 8, of the Tariff Act, "Antimony: oxide, 2c. per lb." Then again Marc further writes: "The recommendations were adopted, and a duty of ¾c. per lb. was placed on crude or needle antimony." In the Tariff Act, p. 32, paragraph 376, we read: "Antimony, as regulus or metal, 2c. per lb.; needle or liquated antimony, one-fourth of 1c. per lb." Of course, if Marc is writing fiction, like Edwin Lefevre, this is fine, but we usually look for facts in the *Engineering and Mining Journal-Press.*

Again, according to the gospel of Marc, we find that the magnesite tariff "was passed almost entirely for the benefit of one firm." How in the name of all that is good and bad can Marc expect such a statement to go unchallenged! If he would read the hearings before the Committee on Finance of the United States Senate he would find over fifty firms interested in the passage of the tariff on magnesite and less than a dozen opposed. If space would permit we would quote the names printed on p. 2081 of the hearing which took place Aug. 27, 1921, showing the proponents of this tariff, and look as we will we cannot find more than a dozen opponents to the magnesite tariff. When we consider this seriously we cannot for the life of us see how Marc can say that the tariff was passed "against the interests of other firms which probably had more unamortized American capital invested in magnesite deposits abroad than the proponents had in the United States." Truly, to stuff such statements down the readers' throats sorely taxes the deglutition.

The gospel of Marc further says that magnesite prices in August, 1922, on crude magnesite, were $8 to $12 per ton, and $30 per ton for calcined. After the tariff was effective, he states that prices were increased to $15 for crude, and $37.50 for calcined, all prices f.o.b. California. As a matter of fact the prices on magnesite have not changed one red cent, and Marc can be referred to some of the biggest magnesite buyers in California, who have been using this material for years, to substantiate this. What Marc should have stated in his article is that the only American firm "which probably had more unamortized American capital invested in magnesite deposits abroad" brought in thousands and thousands of tons of magnesite before the tariff was effective, which it is now selling at a handsome profit, having increased its price about $7 per ton over and above the amount of duty. This is where Marc should have said that they "can now afford to erect a monument to a munificent Congress!"

Furthermore, Marc states the price of Austrian dead-burned magnesite was $16.25 per ton "before the war and before the tariff. These prices would again hold but for the tariff." Where Marc gets this reasoning is again beyond my depth. For example, on Nov. 15, there was a rate hearing on magnesite before the Transcontinental Freight Bureau. Present at that meeting was Mr. P. B. Mossman, vice-president of the American Refractories Co. (which is the firm Marc refers to as probably having "more unamortized American capital invested in magnesite deposits abroad"). Mr. Mossman made the statement to the standing rate committee that the price of Austrian dead-burned magnesite *at that date* was $43.50 per ton Baltimore. The tariff on dead-burned magnesite is $11.50 per ton. Deduct the $11.50 per ton from $43.50, and we have left $32 per ton, which is double the price that Marc said would be the price of Austrian dead-burned mannesite but for the tariff! I suppose Marc would reason from this that he was *half* right.

Aside from all the discrepancies in Marc's article, he makes no mention of the revenue which the various tariffs will bring to the country, and relies upon making the reference that Congress is ill-fitted to make tariff legislation and is economically unsound generally, which is along the lines of the average cartoonist in the daily newspapers and the editor whose pet policy has not been carried out by Congress.

Here's hoping that the next article from Marc will not be so far away from the facts! C. S. MALTBY.

San Francisco, Calif.

Concentration of Rossland Ores in the Early Days

THE EDITOR:

Sir—In his very interesting article on the "Concentration of Rossland, B. C., Ores," published in your issue of Dec. 23, 1922, Mr. Douglas Lay briefly mentions the erection in 1904 of a plant at Trail for the treatment of Rossland ores by coarse concentration by jigs, followed by cyanidation of the tailings after recrushing in Trent mills. He states correctly that the results were far from satisfactory and that the enterprise was short lived. This brief statement does not tell the whole story, however. As I had charge of the construction and operation of this plant and of the experimental milling which preceded it, I wish to record certain interesting metallurgical facts, developed in this work, having a bearing on the subject under discussion and adding to those contributed by Mr. Lay. This statement will also help to explain why this enterprise was not a commercial success.

The preliminary milling, carried out in an old plant

at Silica on car lots of supposedly typical low-grade ores from the War Eagle and Centre Star mines, consisted essentially in dry crushing and reduction by rolls and wet grinding in Chilean mills (discharging through brass screens of from 40 to 60 mesh), concentration, after a rough hydraulic classification, on Wilfley tables, and experimental treatment by cyanidation of the table tailings in intermittently settled charges.

The main purpose was to find out whether tailing thus produced could be successfully cyanided; the concentration was regarded as of secondary importance, provided a fair recovery of marketable concentrate, and a tailing low in copper, could be made. The table work demonstrated that this could be done, and a fairly satisfactory treatment for the tailing was worked out. The concentrate produced was marketed at a profit, as it contained considerable gold and copper.

In the subsequent preparation of the flow sheet for the Trail plant, it was correctly assumed that concentration should, as Mr. Lay states, begin on the coarse material, thereby reducing the grinding expense and unnecessary sliming of copper minerals as well as making a product easier to smelt. This was of special importance in this case, as most of the low-grade ores from the Centre Star mine consisted largely of coarse pyrrhotite, low in gold, with some chalcopyrite adhering or included. Therefore, provision was made for step reduction by crushers and rolls, with mechanical jig concentration covering a range from 4-in. material down to the finest trommel product. Only the fines from the last trommel (—2 millimeter material as I recall it) went to the three Wilfley tables, after hydraulic classification. A picking table for hand sorting of clean sulphide preceded the coarse jigs. The object of all this was, of course, to produce the maximum of clean concentrate as early as possible, with a minimum of sliming of copper minerals, and in this regard the plant was a metallurgical success; unfortunately, in much of the coarser concentrate in which pyrrhotite greatly predominated, the gold and copper content was so low as to render the concentrate scarcely marketable. This tallies with the conclusion of Mr. Lay with regard to a clean pyrrhotite concentrate by flotation: the pyrrhotite content must in such case be regarded as a waste product, to be eliminated with as little expense as possible. The concentrate made by the finer jigs and by the tables was of good marketable grade.

Unfortunately, the metallurgical error was made, in planning the Trail plant, of not providing table concentration for the reground jig tailing before passing this material to the cyanide plant. This error of omission was unwarranted, because it disregarded the line of treatment carried out in the experimental plant, where cyanidation was performed on *table tailing only*.

Before the plant was shut down, I demonstrated this conclusively by cutting off the regular feed to the tables and diverting a portion of the flow from the regrinding mills to them, with startling results: More than 50 per cent of the gold contained therein was secured in 0.6 per cent of the weight by saving separately the thin but distinct band uppermost on the tables. This consisted mostly of arsenopyrite, with no doubt some free gold. The total saving in the concentrate was considerably in excess of 50 per cent of the gold, with considerable copper, though the bulk of the concentrate consisted of pyrrhotite, low grade in itself. The vital fact, however, was that a mineral high in gold and difficult to treat by cyanidation had been passed to the cyanide plant, whereas it should have been removed by tabling, as had been done in the experimental work. This is further proved by the fact that, after the cyanide plant had been shut down, I removed a compact layer of sulphide from the bottom of each treatment tank, apparently consisting mainly of arsenopyrite and assaying over $600 per ton. That was concentration with a vengeance!

The results by cyanidation, in spite of this serious handicap, approached those obtained in the experimental work, and I believe that had it not been for business reasons which prevented, it might still have been possible to operate the plant successfully (at least metallurgically) by discarding the finer jigs and installing enough tables to handle the discharge from the Chilean mills. One important business factor against it was the lowering of the smelter charge on the class of ores we were handling, from $5 to $4 per ton. If the bulk of the ore could have been furnished from the War Eagle mine, a smaller bulk of higher grade concentrate would have resulted. The handicap of having to handle so much low-grade pyrrhotite was a serious one.

Not all of the flow from the regrinding mills was treated, the slime overflow during filling and preliminary decantation being run to waste. This material, consisting mostly of colloids, contained, as I recall, about $1.60 per ton in gold and 0.6 per cent copper. Had flotation been available in its present high state of development, its application to this product would have been justified, and might have rendered the undertaking profitable. Had it been so available, however, it is probable that the flow sheet of the plant would have been radically different, probably along the lines of the work which Mr. Lay so well describes.

C. M. EYE.

San Francisco.

Does the Percentage of High-Grade Asbestos Vary With Depth?

THE EDITOR:

Sir—Some time ago the statement was made that the percentage of high-grade asbestos in the deposits at Thetford Mines, at Quebec, decreased with depth. I sent out questionnaires to ten representative companies, asking for information on the subject, and replies from nine were as follows: Three stated that the percentage of high-grade increased with depth. Four stated that there was no change. One stated that there was no change to 150 ft. and then the percentage decreases. One stated that the percentage of high-grade decreased with depth.

This seems to indicate that there is either no change or that the percentage of high-grade increases with depth.

B. MARCUSE.

New York.

Wanted: A Metallurgical Handbook

THE EDITOR:

Sir—It may interest Mr. von Bernewitz as well as some of your other readers to know that a plan for a Metallurgical Engineer's Handbook, such as he suggested in the *Engineering and Mining Journal-Press* of Feb. 3, 1923, is already under consideration by the McGraw-Hill Book Co., with the writer as editor-in-chief. It will not be a revision of the "Metallurgists and Chemists' Handbook" but an entirely new work.

New York. DONALD M. LIDDELL.

Mining Engineers of Note

W. SPENCER HUTCHINSON

By Ralph H. Sweetser.

THE recently appointed head of the department of mining engineering of the Massachusetts Institute of Technology, W. Spencer Hutchinson, came to this position, which he assumed on Jan. 1, 1923, with an exceptional preparation in all the requirements needed in a man who is to be the successor of the eminent mining engineer and educator Robert Hallowell Richards, who recently retired with the title of Professor Emeritus. Mr. Hutchinson was born in 1870 in Boston, educated in the public schools, and was graduated in mining engineering from the institution where he now teaches, in 1892. His introduction to practical mining was during the summer vacation of his junior year. He went into the iron ore mine of the Lake Superior Iron Co. at Ishpeming, Mich., and worked as a laborer underground, putting in a ten-hour shift at $1.65 for nine weeks. After graduation he was in the office of M. I. T. as assistant to Secretary Harry W. Tyler, until the time of the World's Fair in 1893, when he was appointed curator of the M. I. T. exhibit at the World's Fair in Chicago. In 1894, desiring to get more real mining experience, he went to California and worked underground as a miner in the gold property of the Utica company at Angels Camp, where he obtained much practical experience in the mining and milling of gold ores. In 1897 he became general superintendent of the American Development & Mining Co. at Gibbonsville, Idaho. During 1898-1899 he did experimental work for Professor Richards, helped build an iron-sand washing plant in Virginia, and made special studies and reports on zinc-lead and corundum ores and asbestos deposits. For the next three years he was superintendent of the Boston Get-There Zinc Co., the Missouri Zinc Fields Co., the Federal Zinc Co. and the Three Shaft Mining Co., all in the Joplin district, Missouri. In 1903 he opened an office in Boston and has been engaged in consulting work ever since. In this period of nineteen years he has had a practice that has taken him into many mining districts in this country, Canada, and Mexico, and into five other foreign countries. For several years most of work was in gold, silver, and copper. In 1913 he had his first experience with the magnetic iron ores of New Jersey, when he made an examination of the Richard mine of the Thomas Iron Co. Through following the advice of Mr. Hutchinson, a large deposit of high-grade magnetic iron ore was discovered on the other side of a fault that had baffled the owners of the mine for twenty-five years. Mr. Hutchinson is now a recognized authority on New Jersey and New York magnetic iron ores. In 1916 he examined a large number of chrome ore deposits in California, and during the war made a trip to the chrome ore deposits in New South Wales and New Caledonia, in the course of which he nearly lost his life in a shipwreck. He also has a wide knowledge of the occurrence of the ores of vanadium, molybdenum, and tungsten. On a recent visit to Peru he discovered the new vanadium mineral "melanovanadite." This broad practical experience in mining has given Mr. Hutchinson the best kind of a foundation for one who is to guide the education of mining engineers. He "both knows the right things and the right way to teach them." He has published many professional papers in *Mining and Scientific Press, Transactions* of the American Institute of Mining Engineers and *Engineering and Mining Journal.* In 1898 he married Elizabeth E. Baker, of Dorchester, Mass., and they have three daughters and one son.

W. SPENCER HUTCHINSON

Fortunately for his students and clients alike, arrangements have been made at M. I. T. whereby Mr. Hutchinson will continue his consulting work, thus conserving to the mining industry that convincing and clarifying counsel that has helped so many executives and boards of directors regarding their mining properties. As head of the department of mining engineering of M.I.T. Mr. Hutchinson will be afforded an exceptional opportunity for the practical and scholastic application of that wide experience in the field so requisite as a complement of technical training and equipment. The same sincere personality that wins the confidence of his clients, and the quiet positive way of explaining the facts as he finds them, will be valuable assets for the teacher as they have proved to be for the engineer.

Tunnel Surveying at Potrerillos, Chile

Technical Methods Used in Locating a Long Adit in the Andes and Making a Connection Underground—Many Difficulties Met in the Work—Extreme Care Necessary

By James E. Harding

As a part of its development program, the Andes Copper Mining Co., at Potrerillos, Chile, decided to drive a long adit tunnel underneath its main orebody to serve as a haulage tunnel for conveying ore from the mine to the mill. The tunnel enters the side of a steeply sloping gulch, and its portal had to be selected at a point low enough so that an adit would pass below the lowest known ore occurrence. The depth of the ore was known, and therefore it was only necessary to run a line of levels far enough down the gulch to arrive at a point sufficiently lower than the orebody to give overhead room between tunnel and ore.

When the location of the tunnel portal was decided upon, difficult surveying was necessary to make the workings from the outside satisfactorily connect with a shaft sunk from the interior workings of the mine. The principal problem was caused by the fact that the final connection had to be made on an incline, partly a raise from the tunnel level and partly a shaft sunk from the mine workings.

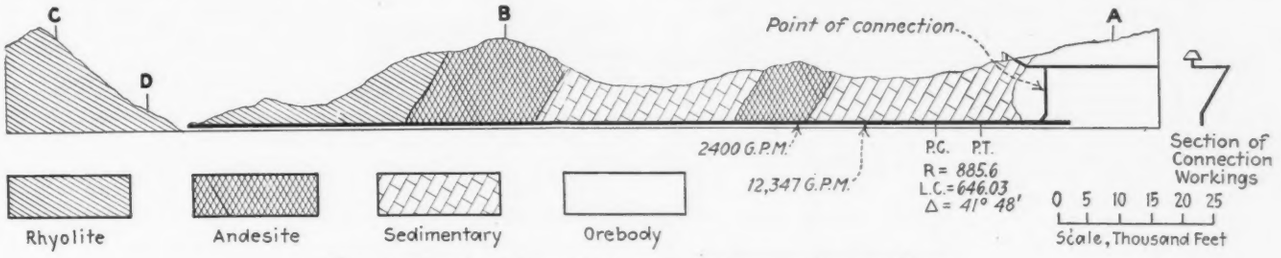


Fig. 1—Section through tunnel and connecting workings.

The tunnel was driven on a tangent from the portal to the 9,827.34-ft. point, from where for 645.03 ft. it followed a curve of 885.6 ft. radius, again going to tangent for a distance of 1,014.07 ft. to the face. That the workings driven for the vertical connection might later serve as an ore pass, a raise was started first on the line of the tunnel with a vertical angle of 45 deg. This raise was driven upward for a distance of 154.62 ft. Then a small station was cut and the raise turned at an angle of 90 deg. to the right and up to a vertical angle of 60 deg. and driven through to a connection with a shaft sunk from above on the same incline.

A Trial Traverse Was Made

In surveying for these workings the first matter to be attended to was to tie the location of the tunnel portal with the co-ordinate system already established at the mine and establish the bearing of the tunnel line. Owing to the mountainous nature of the country under which the tunnel was to pass, this job presented some interesting features. First a trial line was run to the portal location and the bearing of the line approximately established. From point *A* on the profile (see Fig. 1) the line was definitely established from mountain top to mountain top to the points *B* and *C*, it being possible to see both points *A* and *C* from *B*.

From *C* with a backsight on *B*, point *D* was located, on a low ridge on the line *ABC*. This line was established with great accuracy, by four separate surveys. *A* and *B* were located and assumed to be on line. Then setting on *B* with a backsight on *A*, *C* was located, with the instrument both in normal and reverse. This method, even with the instrument in the closest possible adjustment, gave two points for *C* at a distance of about 12 in. from each other. The permanent point *C* was set midway between the two points shown by the varying position of the instrument. In the four surveys for *C*, the middle point never varied by an amount greater than the width of the nail head in the center stake. Then setting on *C*, with a backsight on *B*, the point *D* was set, using the same methods used in setting *C*.

With the line *ABDC* thus established, it was necessary to determine the co-ordinates of the point *D* with reference to the mine co-ordinates. It was known in advance that triangulation would hardly give the exactitude required, the reason being that only such points for stations could be selected as would make triangles of markedly acute or obtuse angles, with vertical angles of sometimes as much as 35 deg. Nevertheless, a triangulation system was laid out from a base line, and the attempt was made. After the work of surveying the triangles was completed, the calculations showed four differing sets of co-ordinates for the point *D*, entirely failing in coincidence, the minimum difference in location being slightly over three feet. This would not do at all. Therefore it was decided to traverse between points *A* and *D*. To avoid the excessive work of climbing steep mountain sides in a high altitude, it was decided to carry the traverse along the bottom of a gulch which extended between the two points.

For the station stakes, a piece of 4 x 4 in. timber about three feet long was sharpened at one end, and driven firmly into the ground with a double jack. In general the stakes were planted about 150 ft. apart, but when irregular ground made it necessary they were spaced more closely, so that a tape could be stretched between them without touching the ground. Instead of nails for points, conical-headed spads were

made in the blacksmith shop, and these were driven with a swedge, to avoid injuring the point, through a numbered plate, firmly into the stake. The reason for the conical head was to enable measurements to be made and sights taken on a clearly visible and exact point.

Between each of the points thus set, the incline distance was measured with a standardized steel tape. To determine the requisite amount of pull for proportionate distances the curve given in Fig. 3 was made up and used. On one end of the tape a spring tension handle was attached, and on the other a pair of specially made, inside grip pliers so designed that they

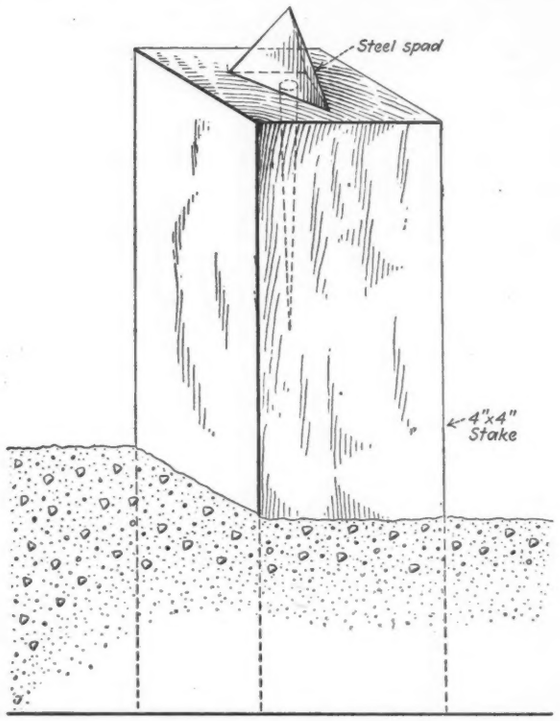


Fig. 2—Transit station.

could be attached at any point and held in the same position by their grip. When measuring, to hold the tape steadily and easily, an ordinary sight pole was thrust through the ring in the spring tension handle or the ring in the pliers at either end of the tape and planted firmly in the ground. By applying pressure to the sight poles, the tape could be stretched to any desired tension and at the same time held steady and still.

Careful Checking of Measurements

The procedure, then, in measuring between any two points, is as follows: stretch tape between points and measure distance roughly; look up in table proper tension for roughly measured distance; with proper tension applied read tape exactly; then re-read; read and note temperature at each measurement. By this method two separate measurements of the entire line were made, and each measurement was checked. When in checking it developed that there was a variation between any two stations of more than a millimeter between the two measurements, a remeasurement was made. This method of measuring gave the inclined distances between stations closely.

To determine the vertical distance between the separate stations, careful leveling was done. Each station was leveled twice, with the level at different locations and vertical differences checked against each other. A double level bubble attached to the level rod enabled the helper to hold the rod vertically. In checking the two levelings no difference developed worth considering.

Thus, between each two stations a right triangle was developed, with the hypotenuse determined by measuring with a tape, and one leg determined with a level. To find the third side, or the horizontal distance between two stations, it was therefore only necessary to solve the right triangle for the missing side. There were in the traverse 105 stations, and the horizontal distance was calculated between each station by double and independent calculations checked against each other.

After the measurement and leveling was completed, the traverse was surveyed with a transit to measure the horizontal angles. At each station the angle was double read to the right and each reading noted. Then reversing the instrument, and backsighting on the previous foresight, the angle was again double read to the left. This method compensates for any maladjustment there may be in the instrument, and leaves the only possible error in the location of the center and leveling. The average of the four readings is the correct angle. By this method the entire traverse was surveyed twice, and then all calculations were made for the co-ordinates of point *D*.

Work Done in Cooler Part of Day

The instrument used on the work was a 38 power telescope with an 8-in. limb reading angles to 10 seconds. Owing to the power of the sun, mirage, wind, and refraction at midday, the work had to be done in the early hours of the morning and abandoned at about 9 o'clock, to be taken up again next morning.

When the calculations were finished, they showed an error of closure of one minute of angle between the two traverses, and location by co-ordinates differing by five-eighths of one inch. Averaging the two sets of co-ordinates reduced the error to five-sixteenths of one inch. The error in closure distributed over 105 stations was slightly over one-half second of angle per station. The straight distance between points *A* and *D* was then calculated from their co-ordinates and the distance found applied on the determined bearing of the line *ABDC*, to give the definite co-ordinates of *D*.

Point *B* was invisible from *D;* therefore, to carry the line into the tunnel, the transit was set on *D* with a backsight on *C* and the first station in the tunnel portal set by the same methods described in the setting of *C*. From station No. 1 stations Nos. 2, 3 and 4 were set in the tunnel. For these stations, the transit was thrown intentionally out of adjustment, to give a comfortable distance between the points shown as foresight when the instrument was in normal and reverse position.

Then the instrument was put in accurate adjustment and all later stations were set by an all foresight method. So far I have seen nothing published about such a method for prolonging a straight line. In the method developed, to set a new station calls for the use of three previously set stations. For instance, at any set-up assume stations Nos. 1, 2, 3 and 4 numbered progressively on the same line. Set instrument on No. 2 and foresight 3 and 4, both of which, if the instrument is correctly located, will appear on the vertical

cross hair without moving the line of collimation. Generally it will be found, when setting up in this way, that the two stations are slightly off coincidence. If they do not show on the same line, the instrument must be moved to make them coincide. When coincidence has been established, it is certain that the instrument is correctly located, and another station may be set.

Before this method was tried out, a rechecking of the line showed that the supposed straight line was off more than a foot in one thousand feet, and it had been found impossible to carry a line which would check. From the trouble that was encountered in keeping the line straight, I am of the opinion that, in all engineering, one of the most difficult pieces of work to accomplish is to carry a dead straight line. If any one happens to be in doubt about this let him make this simple experiment: Set up an instrument supposed to be in correct adjustment, and establish five stations on the same line. Then go to the middle station, sight the nearest in either direction, lock the telescope, and focus on the farther station. See if this station falls exactly on the cross hair. Then plunge the telescope and see where the other two stations fall. This simple test will give an excellent idea of the inaccuracy of even the best constructed transit. However, this digression is getting away from this particular tunnel survey.

The work of surveying had to be carried on while the tunnel was being driven and not interfere with either traffic or work. Much patience was required to do so in the midst of the bedlam of machine drills, constantly passing trains, and hurrying men. Powder smoke mingling with the fog of compressed air rendered visibility low, so that frequent sights had to be taken, with stations set close together. Line plugs were carried close to the face to enable the machine men to spot their holes, and these line plugs were later corrected to exact line to serve as transit stations.

The first real difficulty was encountered at the 7,200 ft. point, where a flow of 2,400 gal. of water per minute was encountered. This flow of water softened up the bottom so that the instrument would not stay put, and walking around it continually threw it out of level. The amount of movement was never over the width of the plumb-bob string in a distance of 100 ft., but such a variation prolonged for 11,500 ft. produces serious error. To add to the difficulty of the work, so much water rained down from the back of the tunnel that it was impossible to keep the lens even reasonably dry and clear. The shield furnished by the manufacturers was inadequate, so a thin brass tube was slipped on over the lens end of the telescope and the joint water-proofed. This worked satisfactorily and kept the lens dry, being used whenever it was necessary to set up under a wet station. Finally a flow of water of over 12,000 gal. per minute was encountered, and this, although diminishing later, made the work more difficult than ever. Under these conditions, the instrument was set up in a deep and swiftly flowing stream and the legs of the tripod were forced as far as possible into the shifty water-soaked bottom. The water fell so fast that it was next to impossible to keep lights burning. Also, because of the water, the weight of the tape was so increased that the standard tension was inadequate in measuring. To diminish as much as possible the error from this source, the tape was oiled and wiped as dry as possible with a piece of cotton waste when measuring.

Fortunately, the location picked for starting the raise to communicate with the shaft which was being sunk from above was fairly dry, and as soon as the raise was above the tunnel level a few feet no further trouble with water was encountered.

In the beginning, this raise was driven straight over the center line of the tunnel for a distance of 154.62 ft., and in this section the line was carried all the way up, by a single sight, from the starting station in the tunnel. After that distance had been driven on a 45 deg. incline a small station was cut and the direction of the raise changed at an angle of 90 deg. to the right, while the inclination was changed to 60 deg. At the turn, a backsight line only 12.5 ft. long could be used, which was dangerous, but nevertheless it had to be negotiated. Also, in all this raise work, vertical angles had to be depended upon for differences in elevation. In the raises the same method of prolonging the line was used as in the tunnel.

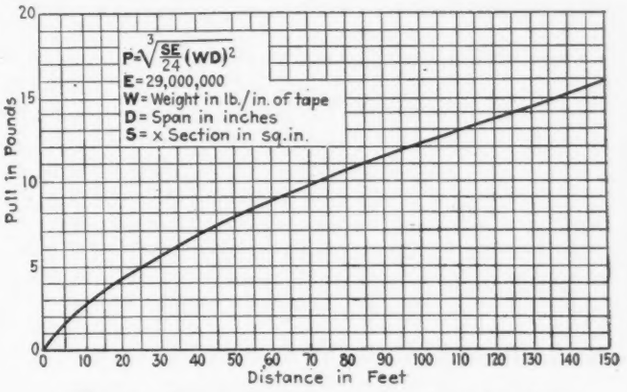


Fig. 3—Curve for determining tape tension.

Naturally, as the shaft and raise approached each other, and the tapping of machine drills could be heard plainly from one heading to the other, the situation became rather tense. Finally the connection was made, and an opportunity was afforded the engineers to know whether or not their work was a success. Checking the final station in the incline showed that the two lines missed an exact closure by only 7¼ in., which was not so bad, considering the difficulties under which the work had been prosecuted.

The credit for making such a close connection, which I consider an excellent piece of work, belongs to K. F. Klein and G. M. Cheney, who did all the instrumental work and made nearly all the calculations on which the final result depended.

To Assist Prospectors in Canada

To enable any person to assist a prospector in Canada, a provision has been inserted in the quartz-mining regulations which apply to all dominion lands, that a prospector, before proceeding on a bona-fide prospecting trip, may file with the mining recorder of the district one or two (but not more than two) powers of attorney to stake, according to a bulletin of the Dominion Interior Department. Accompanying each power of attorney there should be evidence in the form of a declaration that the person granting it has furnished the means to enable the prospector to proceed on the trip. If the prospector succeeds in locating a deposit of minerals which he considers advisable to stake, he can locate a claim for each of the persons who granted him a power of attorney.

The Marketing of Chromite

United States Is Dependent Upon Importations—Mineral Used Principally in Manufacture of Ferro-alloys, Refractories, and Chemicals—Chief Market in the East Near Steel Centers

By Edward Sampson
Geologist, U. S. Geological Survey

THE ONLY ORE of chromium is chromite ($FeCr_2O_4$ or $FeO.Cr_2O_3$). Theoretically pure chromite would contain 68 per cent of chromic oxide (Cr_2O_3) and 32 per cent of ferrous oxide (FeO). In the natural mineral chromic oxide may be in part replaced by alumina (Al_2O_3) and ferric iron (Fe_2O_3), and the ferrous oxide may be replaced by magnesia (MgO). The extent to which these foreign elements enter into the composition effect the value of the ore. Chromite is invariably found in the same geologic association—namely, with the extremely basic igneous rocks or their alteration products, mainly serpentine.

The principal use of chromite is in the making of ferrochrome, which in turn is used in making high-grade steel. The next most important use at the present time is as a refractory substance, the ore being used in lump form, as manufactured bricks, or as a finely ground plastic cement usually containing a small amount of bonding material. Chromite refractories are used principally in the basic open-hearth steel process by which three-quarters of the steel produced in the United States is made.

The chemical industry uses a large amount of chromite, mainly in the manufacture of chromates and bichromates of soda and potash, which find many uses, both direct and in the manufacture of other chemicals. Chromium chemicals are used mainly in tanning, in dyeing cloth, and for pigments.

Ferro-alloy Industry Consumes Largest Amount of Chrome

In 1918, an estimate of the amount of chromite required by various industries was made by the War Industries Board. Recently one of the largest importers made an estimate for me of what he considered the present requirements of the industries to be. The following are his figures as compared with the 1918 estimate. The 1918 estimate was on the basis of a consumption of 130,000 tons and the 1922 estimate is on the basis of a consumption of about 110,000 tons, which is probably too high.

Estimated Consumption of Chromite, in per Cent of Total

	1918	1922
Ferrochrome	52	40
Refractories	17	35
Chemicals	31	25

The great proportional increase in the use of chromite refractories is due mainly to the removal of restrictions imposed in 1918. Chromite is one of the so-called "war minerals." It is a mineral essential for the manufacture of munitions and one which, though normally imported, may, under exceptional conditions, be mined in this country. The production of chromite in all countries for the pre-war year 1913 and for the last five years is shown in the following table. The references indicate the value to be attached to the several figures:

Chromite Produced by Different Countries 1913 and 1917-1922

In Metric Tons

	1913	1917	1918	1919	1920	1921	1922
Australia (*a*)	688	1,142	611	254	1,643	63	(*b*)
Brazil (*c*)	.....	.....	18,141	4,877	3,506	.....	.....
Canada (*d*)	.....	33,317	19,952	8,678	9,993	2,081	814
Cuba (*e*)	.....	17	8,963	14,693	721	610	.....
Great Britain (*e*)	113	303	142	152	1,118	.....	(*b*)
Greece (*f*)	6,930	9,600	2,640	4,070	7,224	5,919	10,000
Guatemala (*c*)	.....	182	1,212	1,686	1,140	401	.....
India (*g*)	5,767	27,495	58,697	37,024	27,231	35,320	31,000
Japan (*h*)	1,326	8,941	6,247	6,012	3,969	3,368	(*b*)
New Caledonia (*i*)	63,370	41,892	55,177	23,548	91,534	29,458	(*b*)
Norway (*j*)	.....	3,957	2,783	460	.....	(*b*)	(*b*)
Rhodesia (*k*)	57,500	66,190	28,382	32,007	54,674	45,529	52,000
Rumania (*l*)	.....	12,000	(*b*)	.....	.....	.....	(*b*)
Russia (*m*)	15,000	(*b*)	(*b*)	(*b*)	2,965	4,013	(*b*)
Turkey (Asia Minor) (*n*)	14,000	(*b*)	(*b*)	(*b*)	25,000	(*b*)	2,540
United States (*o*)	259	44,427	83,753	5,161	2,542	256	200
Yugo-Slavia (*p*)	305	1,805	.....	.....	(*b*)	(*b*)	(*b*)
Totals	165,258	251,268	286,700	138,622	233,260	127,018	.....

(*a*) New South Wales Department of Mines, Annual Reports. Queensland Undersecretary for Mines, Annual Reports.
(*b*) Figures not yet available.
(*c*) Imports into United States, Bureau of Foreign and Domestic Commerce.
(*d*) 1913 and 1917-1921: Canada Department of Mines, Mines Branch, Annual Reports, 1922. Imports into United States up to Sept. 21.
(*e*) Mines and Quarries, General Reports, Part 3.
(*f*) 1913 and 1917: Tableaux statistiques du mouvement minier de la Grèce. 1918-1920: Information furnished by United States consulate general, Athens, Greece, (1920: exports). 1921: Information furnished by Direction du Service des Mines, Athens, Greece. 1922: Estimate.
(*g*) 1913, 1917-1921: India Geological Survey Records. 1922: Estimate.
(*h*) 1913 and 1917: Résumé statistique de l'empire du Japon. 1918-1919: Mining, Japan Department of Commerce, Bureau of Mines. 1920-1921: Information from United States consulate, Yokohama, Japan.
(*i*) 1913, 1917, 1919-1921: Bulletin de l'Agence des colonies (1919-1921: exports). 1918: Statistique de l'industrie minéral en France et en Algérie.
(*j*) Norges Bergverksdrift.
(*k*) 1913 and 1917-1921: Reports of Secretary for Mines, Rhodesia. 1922: Estimate.
(*l*) 1913: Buletinul Societatii Regalii Române de Geografie, Vol. 39. 1917: Montan, Rundschau, Jg. 12, Nr. 23. 1919-1920: Information furnished by United States consulate general, Bucharest, Rumania. 1921-1922: Estimate.
(*m*) 1913: Estimate by Russian geologists. 1920: *Mining Journal*, London. 1921: U. S. Department of Commerce, *Commerce Reports*, June 26, 1922.
(*n*) 1913: Estimate, U. S. Geological Survey *Mineral Resources*. 1918. 1920: Estimate based largely on information furnished by E. J. Lavino & Co., importers. 1922: Estimate.
(*o*) 1913, 1917-1921: U. S. Geological Survey *Mineral Resources*. 1922: Preliminary estimate.
(*p*) Wray, D. A., report of geologist attached to the British Economic Mission to Serbia, 1921.

New Caledonia has produced more chromite than any other country. Most of the output has come from the Tiebaghi mine, which at the present time is furnishing almost the entire supply. However, it is said that owing to the way the mine has been worked in the past it cannot be counted on for its usual large supply for the next year or so until considerable dead work, now under way, is completed. The Tiebaghi mine is said to be the only mine capable of supplying under the present conditions a large amount of chrome ore carrying 55 per cent Cr_2O_3.

Important Producing Fields Abroad

In Southern Rhodesia, the Selukwe district has yielded most of the output. The ore is mined by open cuts at a very low cost. It is shipped from the port of Beira, in Portuguese East Africa. The Darwindale and Lomagundi districts, discovered in 1917, promise to be of importance.

Much chromite has come from Asiatic Turkey, but

the present unsettled political conditions make chromite exportation impossible.

There are two important chromite fields in India—one in Baluchistan, the other in the State of Mysore. The Baluchistan field became important during the war, when a railroad was constructed which greatly reduces the cost of transportation to the shipping port, Karachi. The chromite of the State of Mysore is high in iron and inferior to that of Baluchistan. At present there is little activity in that field. Important deposits have been reserved by the state in anticipation of an increased domestic demand, both in the proposed manufacture of chemicals for the large domestic tanning industry and for projected steel plants.

Chromite mined in Greece at the present time is said to come almost entirely from the Volo mine. The ore is suitable only for use in refractories. A considerable amount was imported into the United States in 1922 for that purpose.

From the foregoing it may be seen that large high-grade deposits of chromite are so few that such deposits can be worked at a great distance from the market. The war demonstrated, however, that small low-grade deposits are widespread. In the United States there are many such in the Appalachian Mountains of the eastern states and in the Klamath Mountains and Coast ranges of the western states. When it became necessary to conserve shipping, small deposits were actively exploited, and 82,000 long tons of domestic ore was marketed in 1918. This was a larger production than ever recorded by any other country, and, in addition, 40,000 tons was mined but not marketed. However, only under such exceptional conditions as existed during the war will a large domestic chromite mining industry be possible.

The main consuming countries of raw chromite are the United States, Great Britain and Germany. France and Italy use little for chemical purposes and buy much of their ferrochrome from abroad.

In the United States, Philadelphia and New York are the principal markets. The principal port of entry is Philadelphia, with lesser amounts coming in through New York and Baltimore. London is the leading market for all Europe. For Continental Europe the main ports of entry are Antwerp and Rotterdam.

The annual world consumption is roughly indicated by the table of world production. The apparent consumption in the United States (domestic production plus imports) is shown below.

Domestic Sales, Imports, and Apparent Consumption of Chromite in the United States, 1913 and 1917-1921

In Long Tons

Year	Domestic Sales	Imports	Apparent Available Supply
1913	255	65,180	65,435
1917	43,725	72,063	115,788
1918	82,430	100,142	182,572
1919	5,079	61,404	66,483
1920	2,502	150,275	152,777
1921	282	81,836	82,118

The demand for chromite throughout the year is constant, as is also the supply. In general, it appears that the consumption of chromite in this country will increase under the present tariff conditions, owing to the partial substitution of chromite for magnesite refractories, magnesite being dutiable and chromite being on the free list.

Under the chemical qualifications of chromite must be considered not only the chromium content but also the amount of various impurities and their relation to one another. In the mineral chromite, iron, magnesium, and aluminum may be present as chemical impurities. In the associated minerals the main impurities are magnesia and silica. For use in making chromium chemicals the chromium content is the main factor, the nature of the impurities being of less importance than their aggregate amount. In making ferrochrome the relation which the amounts of chromium and iron bear to each other is important.

Ferrochrome as marketed contains from 65 to 70 per cent chromium. In the process of manufacture more chromium than iron is lost in the slag, especially when the carbon content of the finished ferrochrome is kept low. Silica and magnesia can be removed with comparative ease by fluxing, but the iron remains. It is interesting to note that if all the iron and chromium in theoretically pure chromite were saved the resulting ferrochrome would contain only 65 per cent chromium, as compared with 75 per cent for the chromite represented by analysis I.

It is the natural substitution of magnesium for ferrous iron that makes a mineral in which the chromium sufficiently predominates over the iron. In chrome ore for refractories it is important to have a low silica content, a high chromium ore not being essential. For refractories some chromite with 38 per cent Cr_2O_3 finds a market, but generally 41 per cent or a little better is required. For the other uses 48 to 50 per cent ore is demanded. A limited amount of ore with 55 per cent Cr_2O_3 is on the market.

The following analyses have been supplied by a large importer of chromite and selected by him as typical of the ore reaching the American market. They all represent lots as sampled commercially and not specimens.

Chromite Analyses

	I	II	III	IV	V	VI	VII
Cr_2O_3	55.40	50.40	55.76	52.60	51.10	41.66	44.45
Al_2O_3	13.19	14.48	10.06	11.32	7.60	18.24	12.18
Fe_2O_3	3.71	2.00	3.05	.70	1.03	(a)	14.22
FeO	12.77	11.70	14.45	13.30	21.44	14.70	(b)
MgO	11.90	10.80	13.32	16.40	12.10	16.66	17.70
CaO	.50	1.00	.65	1.10	.60	5.76	none
MnO	.52	.50	.40	.30	.30	.....	.....
SiO_2	.32	5.50	1.80	1.86	4.50	2.00	6.20
SO_3	Tr.	.14	Tr.	.10	.05	.....	.70
P_2O_5	.12	.....	.....	.....	.....	.....	.064
H_2O +	1.55	3.45	.55	2.30	1.30	.98	n.d.
	99.98	99.97	100.04	99.98	100.03	100.00	95.71
Cr	37.89	34.47	38.14	35.98	34.95	28.50	30.40
Fe	12.51	10.49	13.36	10.82	17.38	11.42	.....
Cr: Cr + Fe	.75	.77	.73	.77	.67	.72	.....

I New Caledonian ore (Tiebaghi mine.)
II Rhodesian hard ore.
III Rhodesian friable ore (average of three analyses).
IV Baluchistan ore.
V State of Mysore ("Madras") ore.
VI Grecian ore (Volo mine).
VII Turkish ore (Macri field).
(a) Included with Fe_2O_3
(b) Probably included with Fe_2O_3

The composition of chrome bricks varies between wide limits, according to the ore that happens to be available at a low price. Two large manufacturers of chromite refractories have been good enough to give their opinion as to the extreme types of ore in use. The results are summarized below. No. 1 represents an estimate of the extremes of each constituent and No. 2 represents two analyses of extreme types of ore. The total iron content is given as Fe_2O_3.

Composition of Chromite Used for Refractories

	No. 1	No. 2
Cr_2O_3	38 to 48	41.05 to 48.57
Al_2O_3	12 to 24	20.01 to 14.13
Fe_2O_3 (a)	14 to 24	15.06 to 20.60
MgO	14 to 18	16.84 to 10.39
SiO	4 to 10	4.91 to 5.52

(a) All iron calculated as Fe_2O_3.

Two grades of chrome ore are marketed, lump and

fine. The lump ore is run of mine and the fine ore is ground to a powder fine enough to be plastic. The ground ore is used largely in patching reverberatory furnaces, and generally contains a small quantity of added magnesite or bauxite, which will cause sufficient sintering to make a bond. Some ore contains the gangue mineral serpentine, a hydrous magnesium silicate, in such proportions as to produce the right amount of sintering without the addition of other ingredients.

Chromite is usually sold on yearly contract or in shipload lots. Sampling is by an independent chemist, and payment is made according to his report. The common terms are 75 per cent on arrival of steamer, and the balance on report of sampler.

The basis on which the price is fixed varies according to the use to which the ore is to be put. Ore for refractories is sold at a flat price with a guaranteed chromic oxide content; for example, 40 per cent, rejectable if below 38 per cent. A minimum quantity of silica is guaranteed in ore for refractory purposes—generally a minimum of from 5 to 8 per cent. Ore for ferrochrome and for chemicals is paid for according to the chromic oxide content. At present such ore is sold on the basis of 50 per cent Cr_2O_3, with an adjustment per unit above or below that figure. The unit is 1 per cent of Cr_2O_3 per long ton. During the war domestic chromite was sold on direct unit-price basis, the unit price varying according to the grade of the ore. The sale of chromite by the long-ton basis is a reflection of the fact that British interests have long controlled the market.

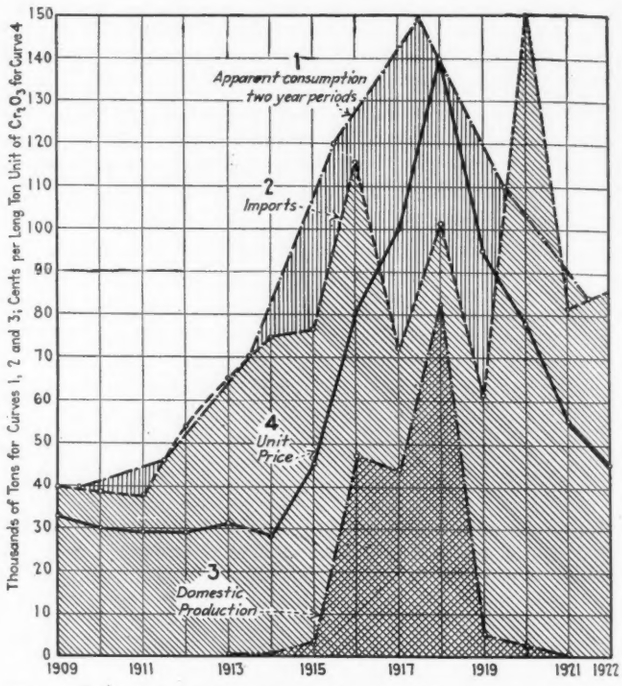
In securing information on the prices of chromite over a period of years it has been found best to reduce the results to a unit basis. So far as possible the unit prices represent 50 per cent ore. The following table and Fig. 1 show the unit prices since 1908. These figures are approximations only, the data on which some of them are based being meager:

Average Prices of Chromite in Cents per Long Ton Unit of Cr_2O_3

1909	33	1914	28	1919	95
1910	30	1915	45	1920	78
1911	29	1916	80	1921	55
1912	29	1917	100	1922	45
1913	31	1918	140		

In 1913, 50 per cent imported chromite sold for about $15 a ton, which is equivalent to 30c. a unit. During the war an increased supply of chromite became imperative. At the same time it became necessary to conserve ships and to bring about the greatest possible exploitation of domestic and Canadian deposits. As importation was restrained the price rose and lower-grade ores became marketable. The climax was reached in June, 1918, when the largest consumer offered to contract for the remainder of the year at the following scale of prices: 30 to 38 per cent ore, $0.85@$1.25 per unit; 38 to 48 per cent ore, $1.25@$1.50 per unit—equivalent to $25.50 a ton for 30 per cent ore and $72 per ton for 48 per cent ore. Under such conditions almost any deposit of chromite could be made to yield a little profitable ore. Nearly 350 operators contributed to the domestic supply. A few mills were constructed, but some of these were poorly planned. Finally such a production was reached that in 1918 about two-thirds of the domestic requirements could have been met by domestic and Canadian ore and half the remainder by ore imported from Cuba, Guatemala and Brazil. In spite of this, nearly one-third of the requirement was imported from New Caledonia and Rhodesia, requiring a four months' voyage per cargo. The effect on the domestic industry was disastrous.

During the latter part of 1922 New Caledonian ore sold for $25@$28 a ton, Rhodesian $23, and Baluchistan ore $18.50. At the same time, chrome brick sold for about $50@$55 a ton and chrome cement for $23 a ton.



Curves showing domestic production, imports, consumption and prices of chromite

In an accompanying diagram various data concerning the chromite industry are presented in graphical form. In curve 1 is shown the apparent annual consumption averaged over two-year periods. This averaging is desirable because of lack of information as to unconsumed stocks of ore. Curves 2 and 3 show the relation between imports and domestic production. It was only the curtailment of imports which made domestic production a factor in chromite market. The relation between domestic production and price is clearly shown by curves 3 and 4.

Quicksilver Discovery to Make Japan Independent of Other Supplies?

A rich quicksilver vein, said to extend for over 7 miles on the surface and to vary in width from 2 to 6 ft., has been discovered near the village of Kita Uonome, in the upper Goto Archipelago, according to the Nagasaki *Nichi Nichi Shinbun*, reprinted in *Commerce Reports*. Assays show the ore to contain 18 per cent of quicksilver, and preliminary excavations indicate that the vein increases in thickness the deeper it is followed. Mining capitalists in northern Kyushu are to undertake the development. None of the quicksilver veins so far discovered in Japan have proved commercially workable, and hence the discovery of this vein is especially welcome, since it should make Japan independent of the rest of the world for its supply of quicksilver.

McIntyre mine and mill with Pearl Lake between

Mining Camps of North America

Porcupine: Premier Gold District of Northern Ontario

First Discovery in 1909—Early History—Only Three Active Producers, but Many Development Projects—Geology of Ore Deposits—Shrinkage Stoping Makes Economical Mining—Outline of Metallurgy—Acute Need for Hydro-electric Power

BY REGINALD E. HORE

WORLD-WIDE RECOGNITION of the possibilities of Ontario as a gold producer is due largely to results that have followed the important discoveries of gold in the Porcupine area in 1909. During the next two years exploration and development were actively prosecuted. Production at Porcupine began in 1912, and as a consequence Ontario's gold output jumped from $42,637 in 1911 to $2,114,086. Production increased rapidly, and in 1916 the year's total was $10,339,259. There was some decrease in output during the last two years of the war, but since then there has been another big increase, and 1922 far surpassed all previous records. This year will record still larger operations.

During the last few years other gold areas, notably Kirkland Lake, have contributed largely to Ontario's output, but Porcupine is still the most important producer of gold in the province. The success at Porcupine is leading to exploration in several other gold areas in Ontario, and in coming years many areas will doubtless be contributing to the output, but for some years to come Porcupine will be the scene of the biggest gold-mining operations in Ontario. Three mines, Dome, Hollinger, and McIntyre, together produced $13,169,301 in 1921, and their total in 1922 was much larger. One Porcupine mine—the Hollinger—is now producing about $1,000,000 worth of gold per month, and its milling capacity is being increased.

The Porcupine area is 140 miles north of Sudbury, and 100 miles northwest of Cobalt; these are mining centers well known for their nickel and silver mines respectively. Porcupine is served by a branch line from the Ontario Government railway, which runs north from North Bay to Cochrane. North Bay is 230 miles from Toronto. The trip from Toronto to the Hollinger mine takes about twenty-one hours.

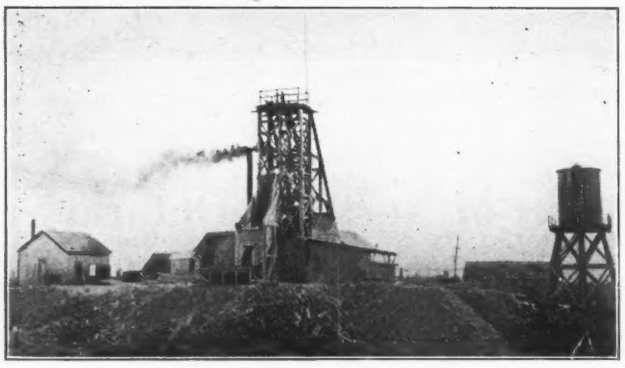
Timmins, at the terminus of the railway, is the chief town in the area. It is built on a sandy slope between the Hollinger property and the Mattagami River. Schumacher is a smaller town on the shore of Pearl Lake. A third town, South Porcupine, is a short distance from the Dome mine and at the south end of Porcupine Lake.

The mines at present producing are the Dome, Hollinger, and McIntyre. The Vipond produced several years ago, and operations here have been recently resumed. The Porcupine Crown was profitably operated for a few years, but work at present is confined to explora-

Dome Mines plant at South Porcupine

tion. The Newray property was formerly a producer, and exploration is now being carried on by diamond drilling. The most notable new work being done is at the Goldale, where a shaft has been sunk to 500 ft. and exploration at that level started. A new discovery was made last summer at the Holtyrex property, and a shaft is to be sunk there this winter. On the Rochester property, adjoining the Hollinger, important exploration work is being carried on in promising ground.

In the Dome area there has been renewal of activity recently. The West Dome and Dome Lake properties

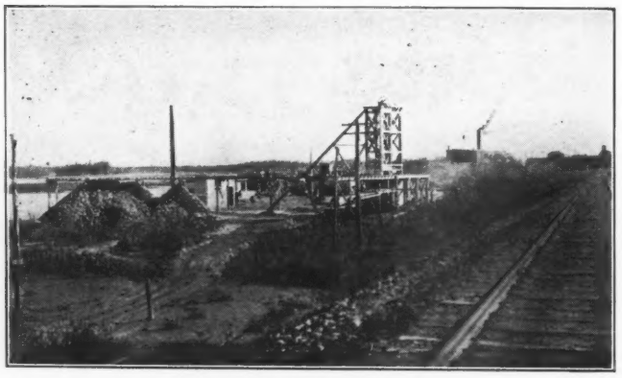


Goldale shaft, Porcupine

have been consolidated, and work has been begun. The McIntyre company is testing property north of the Dome by diamond drilling. At the Clifton a mill has been erected that will be put in operation soon.

In the northeastern section of Tisdale Township, operations are being carried on at the Davidson. It is intended to sink a 1,000-ft. shaft on this property. All of the operations mentioned thus far are in Tisdale Township. In neighboring townships some work is being done. Among the notable new developments is the Night Hawk Lake Peninsula, where a splendid orebody is being developed. Some rich ore was found last summer at the Paymaster property.

When the discoveries were made at Porcupine, in 1909, the area was heavily covered with forest. Material



Rochester shaft, Timmins

was right at hand for buildings and fuel, but there were no means for transporting machinery and supplies. The railway was 30 miles away, and there were no highways.

Roadways were soon cut through the forest, and during the winter of 1910-1911 scores of sleighs were used to haul in machinery and equipment for development work. The following year a railway was built to the Dome and later it was extended to the Hollinger. During these years the operations were carried on by steam power with wood for fuel. The development work done by the use of steam gave results that led to the utilization of water-power from neighboring streams. Operations at the producing properties are now carried on by electric power. Companies that are developing find difficulty in getting power, but an additional source of hydro-electric power is now being developed.

In the early days the district received some serious setbacks from forest fires and strikes. The fire of 1911 was a particularly disastrous one, and ended more than one enterprise. Later the period of high costs and wartime shortage of men and supplies made difficulties for the operators. It was found possible to make headway at some properties even under the most adverse conditions, but development of others has lagged, and work is only now being done that under more favorable circumstances would have been performed years ago.

In the early operations at the Dome mine about 1,000,000 tons of ore was taken from near the surface, largely from an open pit. Below this the ore was lower in grade, and results were discouraging. Then better ore was encountered for a few years. This was followed by a period of high costs and unsatisfactory ore developments. Then at lower levels the Dome came back stronger than before, and now the mine is showing more promise than ever.

Hollinger Deposits Remarkably Uniform

At the Hollinger, mine development has been comparatively steady. The deposits, as compared with those at the Dome, are more regular in both form and gold content. The mine has grown by steady development of persistent oreshoots and by discovery of additional similar orebodies. The Hollinger ore varies in character and in grade, but the impressive feature about the deposits, aside from their number and magnitude, is their relative regularity. The Hollinger has steadily grown as development proceeded and has proved to be much bigger than expected. At the same time it has not changed greatly from its former character.

The McIntyre has provided far more thrills for the operators. This mine seemed likely in the early days to give trouble—and it did. The deposits lacked the regularity of the Hollinger as well as size and values. For some years McIntyre had a very slim hold on life; but later, by the acquisition of adjoining property and development at greater depth, rapidly changed into a profitable enterprise.

Character of Ore Deposits.

The Hollinger-McIntyre series of deposits forms a vein system, standing nearly vertical and inclosed by altered volcanic rocks of the Keewatin series. On Hollinger ground there are a large number of the individual veins or lodes at varying distances apart. Approaching the McIntyre along the strike of this vein system, one encounters a mass of porphyry which is practically barren. One group of veins runs along the south and the other along the north side of this porphyry mass. The rocks along the veins are schistose, pyritic, and carbonated. On either side are more massive and less mineralized lavas. Much of this lava is a dark-colored basaltic rock, characterized by ellipsoidal markings and known as pillow lava. There are rocks in the ore zone that are somewhat similar to these basalts; but others are lighter colored, and sericitic. Whether these are all igneous rocks or in part sedimentary is a ques-

tion. Rocks in the immediate neighborhood that retain evidences of their original character are igneous and the rocks of the ore zones may be similar types altered by solutions carrying carbonic acid, alkalies, sulphides, and silica; or they may be in part sedimentary rocks metamorphosed by such solutions.

Whereas at the Hollinger and McIntyre the ore is in pyritic gray rocks that are believed to be altered igneous rocks, at the Dome the ore is nearly all in sedimentary rocks. These are dark gray colored rocks that were probably formed by hardening of muds, sands, and boulder beds, giving respectively gray slate, graywacke, and conglomerate. The Dome orebodies are great irregularly shaped masses inclosed in these sediments. Igneous rocks similar to those at the Hollinger inclose the sedimentary rocks.

At all three mines the gold occurs chiefly as native metal associated with pyrite. Some of the ore is chiefly white quartz, and some of it contains little quartz. Most of the ore has pyrite, carbonates, and sericite in it, and, in the darker-colored parts, green chloritic minerals. The carbonates contain iron. Outcrops along the orebodies show white quartz in rusty schists, the carbonates turning yellow on oxidation and the pyrite yielding brown and red oxides.

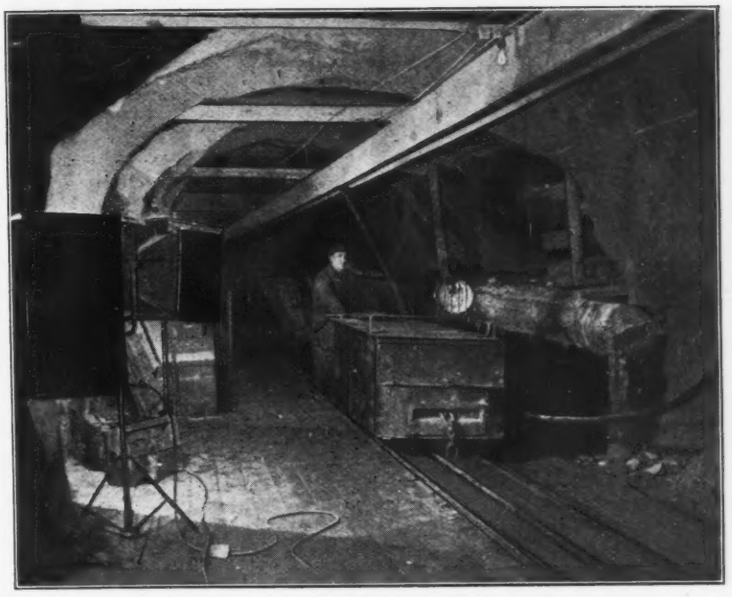
At all three mines good results have been obtained in the development of the lower levels. At the Hollinger the deposits have proved bigger and more numerous than surface appearance indicated. At the McIntyre there has been great improvement in values with depth. At the Dome there has been found a recurrence of good ore. The deposits may confidently be expected to continue to great depths.

Mining Methods.

The Hollinger has been mining about 4,500 tons ore daily, and plans to increase this output. The Central shaft is of six compartments, two of which are in service as skipways. Two compartments now used for mancage ways will later be used as skipways. Two other shafts are used for handling men and supplies. Two five-ton Kimberley skips are operated in balance. The capacity is 5,200 tons per day. Men are hoisted on double-deck cages in balance.

On the levels there are two main tunnels roughly paralleling the ore zone. From this a series of crosscuts runs through the veins. The ore is hauled to the shaft by electric locomotives. Stoping is by the flat-back shrinkage method.

Hospital at the Hollinger mine



An underground station in the Hollinger mine

In drifting, the veins are usually slashed the full width. Then the back is taken down to 17 ft. in height. The drifts are timbered with stulls on 6-ft. centers. Chutes are built every second set on 12-ft. centers. All development work is contracted. Blasting is done by a special crew.

Efficient Mine Equipment.

At the McIntyre, two shafts are being operated, one for men and material and the main shaft for hoisting ore and waste. The main shaft is three-compartment to 1,000 ft. and four-compartment below. The deeper levels are at 125-ft. intervals. Main haulage levels are equipped with ore pockets of 400 tons' capacity. Intermediate levels are connected with main levels by ore passes, which serve as auxiliary pockets.

At the McIntyre, drifting and crosscutting is contracted. Regular practice is to drill, with one machine, and to blast on one shift, and to muck on the opposite shift. In narrow orebodies drifts are slashed for the full width of vein and then cut out to 16 or 18 ft. high. Stulls are placed at 5-ft. centers and chutes built at 25-ft. centers. Most wide lenses are opened by a series of box-hole raises spaced at 25 ft. These raises are 24 ft. high and are connected at the tops by narrow drifts, leaving a solid back of ore about 10 ft. thick. Chutes are built into the box holes, and then the openings are enlarged to the full width of the orebody. Stoping is by the shrinkage method, manways being provided at intervals of 200 ft. Dilution is about 10 per cent. On main haulage levels storage-battery locomotives are used to haul side-dump Granby type cars of 38-cu.ft. capacity. The main shaft is equipped with a hoist designed by Nordberg. Two 4,500-lb. Kimberley skips, in balance, are provided; the rope speed is 1,500-ft. per minute from a maximum depth of 2,700 ft. The hoist is geared to a 300-hp. motor.

At the Dome mine in the early days a large quantity of ore was taken from an open pit, milled down, and hoisted through a sloping shaft. For some years now, however, all work has been underground.

Stoping at the Dome is by the ordinary shrinkage method. The orebodies are opened by drifts and crosscuts and then box holes are put up and a sill is cut out

about 15 ft. above the level. This is enlarged to the limits of the orebody, and then the ore is broken down and about half of it drawn. From manways in the vicinity of the stope, openings are made into the stope about every 25 ft. Much of the ore is broken large, and to facilitate handling of this a heavy crusher was installed underground some years ago. That this is giving satisfactory service is evidenced by the fact that a similar crusher has recently been placed at the 12th level.

Cyanidation Principal Means of Gold Recovery

The ore mined at Porcupine is crushed, ground fine, and cyanided. For coarse crushing Hollinger uses gyratory crushers and a set of rolls. The crushed ore runs into an underground pocket and is thence hoisted to the mill in six-ton skip cars. Here it is reduced to pass a ⅜-in. ring, by ball or rod mills or by stamps, and reground in tube mills. There are 200 stamps and one ball mill. A rod mill has been tried with satisfactory results, and it is understood that rod mills will eventually be used extensively. At the McIntyre and Dome ball mills are used. The Dome uses some stamps, but the McIntyre has none.

At the Hollinger No. 2 mill table concentration is a factor in pulp treatment after agitation. The table tailing is treated by decantation. The table concentrate is thickened and reground in tube mills. Leaf filters are used. Decantation is by the counter-current continuous process. Precipitation is effected by zinc dust. The gold precipitate is filtered in triangular presses, and then smelted in a lead blast-furnace to a base bullion 180 to 200 fine. This is cupelled in an oil-fired furnace giving a bullion containing 810 parts gold and 140 parts silver per 1,000. Of the gold extracted, 48.5 per cent is dissolved in the tube-mill circuit, 45 per cent in the agitators, and 6.5 per cent in the concentrate re-treatment circuit. The loss in solution in 1921 was 8c. per ton of ore milled. In No. 1 mill, Hollinger uses Moore filters, as in the original plant.

Surveying in a Hollinger stope

At the Dome mill amalgamation still plays an important part in the treatment process, but at Hollinger and McIntyre the cyanide process is used exclusively to recover the gold. In early work at the McIntyre a stamp mill and concentration plant was used, and up to 80 per cent of the recovery was by amalgamation, but this later decreased to 60 per cent, and the tailing ran high despite careful concentration, and the amalgamation-concentration process was then discarded.

At the McIntyre reduction is accomplished by coarse breakers, rolls, and Hardinge ball mills. The product is ground unusually fine in tube mills working in closed circuits with Dorr classifiers. Solution by cyanide is effected during grinding and further by agitation. The bulk of the dissolved gold is recovered from the overflow of the primary thickeners, and most of the remainder by use of continuous counter-current decantation.

Carbonaceous Ore Presents Problem

During the last few years A. Dorfman, mill superintendent at the McIntyre, has given much attention to the problem of treating carbonaceous ore encountered in some parts of the mine. This material is not put through the mill, because the carbon precipitates the gold, giving a poor recovery. A satisfactory recovery from such material can now be obtained by grinding in water, to which a little oil is added, and then treating this pulp in agitators with cyanide. The oil, a mixture of fuel oil and gas oils, effectively acts as an agent for neutralizing and destroying the precipitating properties of the carbonaceous rock. This process can be used when ore containing such material is mined. Present practice is to avoid sending such ore to the mill, as only a small proportion of the ore requires such treatment.

At the Dome mill during the last two years changes have been made to effect finer grinding and longer treatment of the ore which is higher grade than the ore which was being treated when mill extensions were made some years ago. The ore is now ground so that 92 per cent passes a 200-mesh screen. Additional Pachuca tanks to permit increased time of treatment were put in early in 1922. The regrinding mills have been equipped with special liners, and iron balls are used instead of pebbles. At the Dome over one-half of the gold is recovered by amalgamation and 40 per cent by precipitation from cyanide solution. The total recovery last year was 95.13 per cent of the gold in the ore.

The increase in the scale of operation at the producing mines and the renewal of activity on other properties have been delayed by a shortage in power. The Hollinger program of expansion has particularly been modified because of lack of the power desired for the proposed larger plant. The power company which supplies the mines is at present developing additional power. The Hollinger company has recently received favorable action on its application for the right to develop power on the Abitibi River. Just at present the power shortage is delaying new development, and steam plants are being installed where it is desired to get work done without waiting for the completion of electric power projects. These steam plants serve for limited operations and will be useful auxiliaries when electric power is in use. Increased water-power development is the thing most needed at Porcupine now; fortunately relief seems to be forthcoming.

A. F. Brigham is general manager for Hollinger Consolidated Mines, Ltd. He came to Porcupine a few years

ago after a long experience in South Africa, succeeding Percy Robins.

R. J. Ennis is general manager of McIntyre-Porcupine Mines, Ltd. He has been identified with the enterprise ever since it was a baby, and to his skill and resourcefulness much of the success of the company is due. He has had the satisfaction of seeing the mine grow from a prospect to a big and profitable producer under his own supervision.

H. P. De Pencier is general manager of Dome Mines, Ltd. His knowledge of the property was turned to good account when difficulties arose, and he guided the Dome operations through a bad period. His exploration work has had results that justified his early good opinion of the property. He and his superintendent, C. W. Dowsett, have been markedly successful in finding ore, and, in fact, have done so well that the present problem is to treat the higher-grade ore in a mill designed for low grade. Mr. Dowsett had the mill in good working order, and then he began to work underground and helped Le Pencier to find new metallurgical problems. Some of the ore recently opened up is exceedingly rich, and the average is much above that of previous years.

Raising a manway in a Hollinger stope

At three of the properties under development the men in charge are representatives of Cobalt silver mining companies. At the Goldale, work is under the supervision of Harry Kee, manager of the Kerr Lake Mines, Ltd. The latter company is operating the property owned by Goldale Mines, Ltd. Harry J. Stewart, of the Crown Reserve Mining Co., supervises work at the Porcupine Crown. Mr. Stewart is also in charge of work at the Crown Reserve's new property at Pancake Lake. At the Newray, exploration is in charge of John Redington, of Coniagas Mines, Ltd. The latter company has the property under option.

At the Consolidated West Dome Lake mine, H. H. Stevens is in charge. At Davidson Consolidated Mr. Bent is in charge of the work, and R. C. Fielding is consulting engineer. The Porcupine V. N. T. mine work is supervised by J. M. Bell. A. S. Fuller is manager of the Premier Paymaster. Ernest Loring is in charge of work at the Rochester. At Night Hawk Peninsula mine, A. R. Globe is general manager.

The Mining of Medicine

The word "mining" usually causes to flash on the screen of one's mind the picture of mighty coal breakers and long strings of gondolas, or headframes and mill buildings perched on mountain sides; fuel and metals pictured in the mind. There is one mine in the United States, however, whose product is as queer as its locality. The mine is situated on one of the salt domes of the Gulf Coastal plain, and the product is medicine.

The first white settlers in the northern part of Brazoria County, Tex., were attracted to a big mound rising 80 ft. above the surrounding plain, which later became known as Damon Mound. On the side of this hill was a hole where the Indians scraped up a certain mineralized earth, leached it, and made medicine. "Sour earth" they called the raw material. These same settlers, being far from the centers of population and medical aid, were forced to rely largely on simple home remedies, and, naturally, followed the practice of the redmen in the use of this substance. In later years a company was formed, which, taking advantage of the modern habit of consuming patent medicines, proceeded to dig this dirt on a larger scale and to manufacture a patent medicine which it sells under a trade name.

The mine is simply a shallow hole from which probably 200 or 300 tons have been removed by hand; it is covered by a "shaft house." The "ore" is a sandy material containing salts of calcium, magnesium, sodium and iron, and free acid. The mineralization was undoubtedly produced by circulating waters, and possibly gases, from the cap rock of the dome. This cap rock consists mainly of limestone and anhydrite, with considerable native sulphur. A large body of rock salt lies below the cap rock, and unconsolidated sediments, containing pyrite, overlie it. The source of the minerals accordingly is readily apparent.

After mining, the earth is allowed to stand in shallow bins in sheds so constructed that air circulates freely, where it "cures"—a process of oxidation, no doubt. It is then shipped to Houston, where it is given a treatment, briefly described as boiling, to dissolve the salts, and filtering to remove the solids. The liquor is then bottled, after being brought to the proper degree of concentration, labeled, and put on the market.

The manufacturers assert that this medicine is a remedy for rheumatism, indigestion, stomach disorders, impoverished blood, general debility, eczema, constipation, and other internal disorders, and that it may be used locally as an antiseptic and astringent, with great benefit. It certainly is versatile!

Byproducts From Wisconsin Zinc Ores

Statistical reviews convey the impression that the Wisconsin zinc district is of importance only as a zinc producer, but the byproducts deserve mention, states the U. S. Bureau of Mines in "Technical Paper 301." Besides the lead, the ore contains two constituents, marcasite and limestone, that can be segregated and marketed. Marcasite is the source of sulphuric acid, and ground limestone is required for agricultural purposes. The demand for tailings for roadbeds and for concrete already exists, and farmers are learning to appreciate the value of fine limestone for improving soils.

Mining History of Mexico—I

A Review of the Development and Vicissitudes of the Industry from the Conquest by the Spaniards Down to the Present Day

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IN COMMON with the political history of Mexico, the mining history of the country is divisible into five distinct phases or epochs, and, unlike that of the United States or of Europe, is not a history of continuous progressive expansion and achievement which experienced temporary reverses due to economic conditions, but is one of intermittent expansion and stunning reverses, produced by complete and rapid political upheavals.

The major periods of the political history of the country south of the Rio Grande are: (1) the aboriginal or pre-Conquest; (2) the colonial; (3) the period of economic and political chaos from the attainment of independence to the establishment of a stable government; (4) the period of stable government under Diaz; and (5) the recent period of revolutions and attempted stabilization of government.

The major periods of the history of mining conform to those of the political. The establishment and destruction of government in Mexico has twice in its history resulted in the establishment and practical destruction of a mining industry.

Colonial Period Characterized by Mineral Discoveries

The subject of pre-Conquest mining, though extremely interesting, cannot be discussed in this review, and the interested reader is referred to "The Letters of Hernando Cortez" (Francis Augustus MacNutt); "Storia Antica del Messico," by Clavigero; "History of Mexico," by Lorenzana; "Aboriginal Mining in Mexico," by F. J. H. Merril, *Engineering & Mining Journal*, Vol. 82, p. 822; and "Gesammelte Abhandlungen," by Edward Seller.

The primitive and isolated character of Mexico's pre-Conquest civilization, together with its mineral wealth, made it unique and resulted in a conquest more dramatic and romantic than any other in modern times. The character of the earlier *Conquistadores* and the political situation in Europe necessarily resulted in development of a type of colonization distinct from that of the United States. The early conquerors were largely adventurers and religous zealots prompted by a desire to attain wealth or convert the "heathen," or both. The later phases of the conquest were characterized by extensive exploration, quick subjugation of the indigenous population, and permanent occupation of the conquered territory. However the indigenous population might have fared had it not been for the country's wealth in gold and silver, these metals were certainly responsible for the completeness of the conquest and, in a large measure, for its cruelty and brutality. The early colonial history is little more than an account of the successive discovery of rich silver deposits and the resulting foundation of towns by the conquerors, among which must be noted Zacatecas, San Luis Potosi, Chihuahua, Parral, Nuevo Leon, Monterey, and numerous other important Mexican cities. Cleland[1] states that, "Indeed, from Mexico City to the Rio Grande, outside of a few port towns on the Gulf coast or the Pacific, such as Tampico or Acapulco, one can scarcely find today a Mexican city of any size that was not established directly as a result of a mining boom."

In addition to stimulating exploration and settlement, the mining industry constituted the basis of economic life, and its successful operators became the basis of the social system of early Mexico. The acquisition of wealth by people engaged in mining, many of whom were of humble origin, founded the upper class, and a number of mining families were raised to the nobility by the King of Spain. Wealth so easily acquired by people unaccustomed to it resulted in a remarkable development of arrogance, intolerance, ostentation, and class bigotry. The agricultural industry was undertaken and developed principally to supply the mining communities, and existed largely as an auxiliary to the mining industry. The local government and the Crown also derived the principal part of their revenue from mining taxes and fees—from the monopoly of or the tariff upon materials absolutely necessary to the mining industry. The Church also embraced the opportunity created by the exploitation of the country's mineral resources, and it grew and prospered upon the mining industry. The magnificent cathedrals and great wealth of the early Church was the result either of special levies or gifts of those who had grown wealthy in mining.

Labor Scarce in Colonial Days—Treated Cruelly

The most serious problem confronting the mine owner in early days was the lack of labor. Whether the result of the natives' unwillingness to work underground, or merely a characteristic of the conqueror's policy and method of asserting his superiority, the natives were rapidly reduced to a state of cruel and abject slavery totally new to most of them. Under this (the "mita") system, entire villages could be transported to the mining districts and forced to work in the mines. Negro slaves and condemned prisoners were also used in the system in an effort to make up the labor deficiency. Conditions among the native slave labor were horrible

[1]Robert G. Cleland, "The Mining Industry of Mexico—A Historical Sketch," *Mining and Scientific Press*, July 2, 1921, Vol. 123, No. 1, p. 13.

beyond expression. Their lot consisted of cruelty, brutality, abuse, privation, and disease, which, with accident, carried them off in thousands.

Cleland[2] quotes a Spanish writer, with a reservation that is perhaps somewhat exaggerated, as saying:

"The Indians came from seventy leagues and upwards, bringing provisions and whatever was needful, and when they had arrived the Spanish mine masters would detain them for several days to do some specific work. The provisions they had brought for themselves were soon exhausted and the poor wretches had to starve, for no one would give them food and they had no money to buy it. The result was that some died on their way to the mines, some on their way back, and some just after they reached home.

"The number of deaths was so great that corpses bred pestilence and for half a league around a certain mine and on the greater part of the road to it, one could scarcely make a step except upon dead bodies or the bones of men, and the birds of prey coming to feed upon these corpses darkened the sun."

The "mita" system was too horrible to endure, even with the arrogant Spanish conquerors, and gradually it was replaced by a system of peonage under which negroes, Indians, and *mestizos* (mixed breeds) furnished the bulk of the labor supply. This system of peonage developed in effect into a caste system under which the son, without his consent, inherited the occupation of his father. The conditions, however, were still far from satisfactory, and though measures to protect the laborer from unnecessary danger gradually became law, the enforcement of such laws was never undertaken seriously unless the safety of the mine itself was involved. In this connection it is interesting to note that the Spanish Crown was inclined to regard the native Mexican and mixed breeds as wards and was disposed to protect them against oppression, but unfortunately this disposition of royal protection never exceeded in effect "an impressive monument of benevolent intentions" which were utterly defeated by the resident officials and colonists.

Labor Severe and Conditions Unhealthful

The mine inspectors evidently were neither conscientious nor competent as a class, and consequently distress and individual accidents were of appalling frequency, even as late as the close of the colonial period. The work required of the peons, even excepting accidents, was exceedingly oppressive and unhealthful. The *tenateros* (packers) who transported ore and water in rawhide bags, according to Humboldt,[3] remained continuously loaded with a weight of 225 to 250 lb. and were constantly exposed to a very high temperature underground, ascending eight to ten times successively, without intermission, stairs of 1,800 steps. The severity of the labor of the *tenateros* was, however, not so unhealthful as that of the *barenadoras* (the powder men), whose average life was about thirty-five years.

The surface labor conditions were apparently also highly conducive to disease. Blindness was a common result of the dust and glare of the *patios*, and numerous women and children, who broke ore, were sufferers from it.

The smelting operations were even less healthful than those of ordinary mining. In this work the laborer was continuously breathing poisonous gases generated by water poured on hot slag. Disabilities from working conditions and excesses resulting in hideous deformation and paralysis of hands and feet were common among these laborers.

Under the peonage system, however, the mine employee for the first time received compensation for his effort. His pay is reported to have been about $5 per week of six days, which, in view of the time and conditions, would have been high were it not largely offset by the iniquitous practice of paying in goods instead of money, at exorbitant prices, and the compulsion of the employee to accept articles for which he had no use in lieu of compensation. The abuses were so serious and disgusting that the codes of Carlos III in 1783 forbade the payment of wages in "merchandise, effects, fruits, or provisions." The same code required the proprietor to pay his men weekly in coin, bullion, or ore, and provided a severe fine for an evasion of the ordinance or reduction in the rate of wages "established by long usage and adopted in all the mining districts."

Many authorities on early mining in Mexico, notably Francisco Gamboa, wrote in 1761 that the miners were superstitious, licentious, drunken, careless, thieving, improvident, and lazy. However, the limitations placed on his life and the enforced character of his labor, even under the peonage system, could have resulted in little less than carelessness, laziness, and licentiousness.

The miner's barbaric love for display, and weakness for strong drink, both of which the ore buyers used to their advantage, consumed most of his earnings and thefts. The present instability of Mexican labor, both political and economical, is but another result of the laborer's inexperience in freedom and the ordering of his own life, due to a system of bondage under which he lived for most of the time since the days of Cortez.

Colonial Code Regulated Industry Strictly

Mining, being the principal source of the great revenues received by the Spanish Crown and its Mexican officials, was soon after the Conquest the subject of many royal regulations, as well as regulations of the individual colonies and provinces. The mining code so developed soon became elaborate, and regulated the conduct of industry to a degree rare in the history of the world except during the recent war with Germany. The mining code of early Mexico, which in reality is the basis of the Mexican mining law of today, consisted, according to Cleland,[4] of five parts: (1) mining ordinances in effect in Spain prior to 1584; (2) the so-called code of Philip II promulgated in the colonies in 1584; (3) royal decrees of various dates, generally dealing with specific and sometimes purely local matters; (4) regulations of individual colonies or provinces; and (5) a systematized, scholarly body of laws issued by Charles III in 1783 and known as the New Code.

The code of 1584 and all the succeeding regulations provided that all deposits of gold or silver, regardless of whether they were situated in public or private ground, were the property of the Crown and were open to public denouncement. Consequently, everyone not enslaved or held to his employment by some other system was free to prospect the public and private land and was obliged to pay only for such damages as his prospecting might cause.

Under colonial law the pertenencia, or unit of concession, was of various dimensions under different codes. The original pertenencia was apparently of rectangular shape and uniform size, with a surface area 50 x 100

[2] *Op. cit.*, p. 16.
[3] Humboldt, "Political Essay on the Kingdom of New Spain."
[4] *Op. cit.*, p. 16.

varas (one *vara* equaling 33 inches). Later in addition to the ordinary pertenencia, the discoverers' pertenencia was created, which was 60 x 120 *varas* in size. These latter dimensions under Philip II became the dimensions of the ordinary pertenencia, and the discoverers' pertenencia was increased to 80 x 160 *varas*. Throughout the colonial period the pertenencia was indivisible and its boundaries consisted of vertical planes extending to indefinite heights and depths. Among other things which the colonial codes provided for was the preventing of careless working of the mines and the requirement that all claims held should be worked or forfeited.

Both the Crown and the local government imposed numerous taxes and monopolies upon the mine owners, which at times were so onerous that mines were shut down. Among them was the royal monopoly on gun powder and mercury used in the amalgamation of gold. The mercury monopoly was a simple and effective source of revenue to the Crown and the cause of much discontent and trouble to the mine operator. Gun powder was so indispensable to the industry and the royal control so ungenerous that smuggling and illicit manufacture were extensively practiced.

One of the taxes was a royal tax of 20 per cent on the gross output of metals. The percentage was later reduced to 10, but the reduction was largely compensated for by the imposition of assay fees and coinage dues and the prohibition of the use of uncoined or unstamped gold or silver in trade. In northern Mexico, at considerable distances from the seat of authority, this latter regulation could not be enforced, and uncoined silver was the medium of exchange, though its use resulted in considerable losses on account of its being greatly discounted in trade.

Mining Practice and Equipment—Heavy Work by Hand

In addition to the scarcity and undesirable character of the slave and peon labor, the Mexican miners were handicapped by inefficient machinery and often by inefficient use of the machinery known. Consequently, practically all of the heavy work now accomplished by machinery was done almost entirely by manual labor. The *"tenateros,"* with rawhide bags, climbing steps or ladders, were the commonest means of raising the ore to the surface, and it is understood that about three were required for each powder man employed. Some of the larger mines, such as the San Ramon, at Pachuca, used horse whims. The San Ramon is reported to have used twenty-eight whims, each pulled by forty horses, at a cost of more than $1,500 per day. The use of horse whims required large shafts, among which was the Tiro General of the Valenciana, which was octagonal in shape and about 33 ft. in diameter. This shaft reached a depth of 1,700 ft. and cost more than $1,000,000.[5]

Some of the larger mines were drained partly at least by expensive *socabons* (adit), but *tenateros* carrying the water out of the mine in rawhide bags, or raising it by *malacates* (crude horse whims), were the commoner methods of drainage. Rawhide bags used in hoisting were of nearly one-half ton capacity, but on account of striking against the walls, wore out very rapidly and were of relatively high cost.

The ordinary miner was an excellent prospector and a good judge of ore and its value. These faculties are indicated by the fact that few new gold or silver districts of any great consequence have been discovered in Mexico since colonial days. Apart from the ordinary miner's skill, the industry suffered tremendously from the want of technical training. Humboldt[6] has estimated that two-thirds of the powder used was wasted. Gamboa,[7] the authority on colonial mining and a trained engineer, states that the "mine surveyors" and superintendents were "strangers to the profession and ignorant of its rules." This latter condition prompted the ordinance of 1783, which authorized or ordered the creation of a school of mines for the purpose of training mining men. The revolution, however, prevented this experiment from being carried to a successful conclusion, and it was a good many years before it was again attempted.

Metallurgical Processes Few

As may be expected under such conditions, metallurgical processes were probably few in number. Silver was recovered principally by smelting or amalgamation through the medium of the famous *patio* process discovered in 1555 by Bartholome Medina. It is estimated that probably at least 75 per cent of the colonial production of silver and practically all of the phenomenal silver-mining development were the result of Medina's discovery. Salt, *magistral*, lime, and mercury, so essential in the *patio* process, were items of considerable expense, due either to the distances which they had to be transported, or to the royal monopolies. *Magistral* (copper sulphate) was either mined in the oxidized outcrops of copper deposits or was prepared from chalcopyrite.

In the amalgamation process a large part of the quicksilver was lost, and the actual process of amalgamation was never developed to so high a degree of efficiency in Mexico as it was in Europe. The ores which could not be treated by the *patio* process were smelted and refined by other methods. The silver districts in Mexico up to the present contain numerous ruins of *hornos* (small adobe furnaces), in which the ore was smelted. These furnaces differed somewhat in various places, but were essentially similar and all of small size. Those in common use in the Santa Eulalia district had a capacity of about 100 lb. of charge, and the blast was supplied by hand, mule, or water power.

Arrastre Commonly Used on Gold Ore

The *arrastre* (a crude grinding mill) was the commonest machinery used in the extraction of free gold from its ore, and usually consisted of a rock-, clay-, or log-lined circular pit about 12 ft. in diameter and 3 ft. deep, the bottom of which was lined with flat stones, the cracks between which were plugged with clay. The grinding apparatus consisted of flat-bottom stones weighing from 500 to 800 lb., attached by ropes to a boom, which in turn, was attached to the lower part of a vertical wooden shaft socketed in the center of the grinding floor. Another boom or sweep was attached to the upper part of the shaft, to which horses and mules were hitched. The ore, after being broken into pieces about an inch in diameter, was slowly ground to powder in the *arrastre*. The bottom of the mill was flooded to a depth of 5 or 6 in. by a stream of running water, which carried off the pulp. The powdered ore was amalgamated with mercury and, under favorable conditions, a recovery of about 50 per cent was effected.

[5] Mexican Year Book. Cleland, p. 263.

[6] *Op. cit.*

[7] Francisco Gamboa.

In addition to the onerous taxes and monopolies, insufficient or unwilling labor, and crude mining and metallurgical methods, the lack of adequate capital was a serious handicap to the development of the industry. The joint stock companies which played such a significant part in the development of the contemporaneous English colonies were unknown in Mexico. Partnerships and leases were probably the most highly developed methods of co-operation known to the early Mexican miners. This condition, coupled with the character of the mine owner, whom Francisco Gamboa calls "prodigal, unlimited in his indulgence and expenses, luxuries, and vices," greatly handicapped the development of the ore deposit of medium grade. Bonanza orebodies, of course, financed themselves. An effort was made by Charles III to establish a mining bank in Mexico with a part of the coinage dues, for the purpose of supplying capital for the development of new mines. This attempt was successful and beneficial for a short time, but at the outbreak of the Napoleonic wars in Europe its funds were requisitioned by the Spanish Government and lost for all time to the mining industry.

Probably the most common method of obtaining working capital in the early days consisted of the co-operation between the mine proprietor, the ore buyer, and the wealthy merchant. The ore buyer, or *rescatador*, was advanced funds by the merchant and supplied the miner with capital by buying the ore at the mine as soon as it reached the surface. The ore buyer then sold, or reduced the ore and sold the silver, to the merchant, who had advanced the money, for a sum considerably below the market price of the metal. Under such arrangements operating capital for current expenses was supplied miners, but the rates of interest were too excessive to make available the capital necessary for large-scale development, and the merchant probably realized the most profit from the undertaking. In consideration of the character of the wealthy mine owner, who almost invariably derived his wealth from bonanzas, it is not surprising that he made little or no provision for working capital or for development of his mine when the bonanza ore was exhausted, or to meet unexpected demands resulting from flood or fire or special assessments, taxation and other causes.

Decade of Revolution Wrecks Mining Industry

The direct causes of the revolution lasting from 1810 to 1821, which freed Mexico from the oppressive yoke of the conquerors, are of no importance in the history of mining, but the indirect causes were of importance to the mining industry after the revolution, and their effect upon the national, political, and economic life of the new republic are factors in the industry today. In general, the true cause of the revolution was the cumulative effect of three centuries of misrule and frightful injustice characteristic of Spanish colonial government and without parallel in modern history.

Three centuries of slavery, peonage, and injustice are not the best developers of democratic citizenship and government, so there is little wonder that the country in its first efforts to govern itself was soon plunged into chaos. The mining industry was the great industry in colonial Mexico, and consequently suffered most in the political upheavel which resulted in political freedom of a people extraordinarily unfit for it.

The close of the colonial period found the mining industry at its height, despite the disadvantages under which it developed. The annual production of gold and silver was between $20,000,000 and $25,000,000, the price of mercury was lower than ever before, and the duties upon supplies had been reduced. The Crown had recently embarked upon a policy more generous than ever before, and as a part thereof had established mining banks, under royal control, for the purpose of providing funds for the development of mines, a school for the training of mining engineers, and numerous lesser reforms and aids.

In spite of the apparent prosperity and progress, the smouldering discontent suddenly broke into a storm of revolution, accompanied and followed by brigandage, bloodshed, treachery, and destruction. Ten years later the entire country, including the mining industry, was reduced almost, if not quite, to ruins.

H. G. Ward, British chargé d'affaires in Mexico from 1825 to 1827, states:[8]

"The civil war entirely destroyed the chain of communication between the highest and lowest classes of mining speculators. In many districts the *haciendas* of the *rescatadores* were ruined, as were the machinery and works of the mines themselves. In others, water was allowed to accumulate to an immense extent, in consequence of the suspension of the usual labors; while in all, the merchants who had before supplied funds for carrying on the different operations, withdrew their capital as soon as the intercourse between the seat of government and the provinces was interrupted. In the years 1811 and 1812, the agricultural produce of the country likewise decreased so rapidly that it became difficult to procure the means of subsistence. The mining towns were surrounded by insurgent parties, which occupied the whole of the open country, and rendered it impossible either to receive supplies or to make remittances without the protection of a large escort; while the exactions of the officers, by whom these escorts were commanded (exactions which were reduced to a system, and in which the viceroy himself largely participated), doubled the price of quicksilver and every other article consumed in the mines; and thus reduced the value of silver to the miner so much that the marc did not repay the cost of extraction, even with the richest ores. The poor ores were allowed to accumulate untouched.

"This was the real evil of the revolution. It was not the destruction of the 'material' of the mines, however severe the loss, that could have prevented them from recovering from the shock, as soon as the first fury of the civil war had subsided; but the want of confidence, and the constant risk to which capital was exposed—which, from being in so tangible a shape, was an object of attraction to all parties—led to the gradual dissolution of the system, which it had required three centuries to bring to the state of perfection in which it existed at the commencement of the War of Independence."

Physical Damage to Mines Serious

The loss to the mining industry through the destruction of "confidence" cannot be minimized, but according to contemporaneous and later historians, observers, and engineers, the seriousness of the destruction, caving, flooding, and high-grading of the mines is underestimated by Ward. Furthermore, the intense participation in the revolution and brigandage by mine labor, thoroughly disrupted, discolated, or destroyed it. During the revolution the original mine owners, mostly Spaniards and royal *mestizos*, had been killed or driven from the country and the old hand-to-mouth system of merchant-*rescatadores*-operators financing had been destroyed. As a result of these conditions, the value of metal production soon decreased to

[8] "The History of Mexico."

about $4,000,000 per annum. Domestic money for the financing of the industry was not to be had. The only alternative was foreign capital.

Foreign Capital Enters—Early Ventures Fail

Foreigners had been excluded from Spain's colonies and consequently the mineral wealth of Mexico had been forbidden foreigners through the colonial period. The first step in inducing foreign capital to come to Mexico was the extension to foreigners of permission to hold shares in Mexican mines. This was followed by extension of an invitation to capital in both Europe, Spain excluded, and America through government and private agents to invest in Mexican mines and mining development.

The reports of Mexico's fabulous wealth, supported in a measure by Baron Alexander von Humboldt's remarkable work, the "Kingdom of New Spain," made the encouragement of foreign capital easy, but the effort was doomed to failure. The conditions were unstable and the time was not ripe.

Numerous English, French, German, and American companies invested great sums in mining enterprises. The British companies were the largest investors and losers, and by 1835 all but a few had withdrawn. A few years more and all but one or two, which were ultimately successful, had acknowledged the dismal failure of the enterprise and had been compelled to abandon it.[9]

Government was more or less unorganized, ineffective, and changeable, particularly in the northern states. The country was overrun by lawless bands of soldiers or outlaws, who robbed, murdered, and levied tribute upon the mining companies and all others who could pay it. The Comanche and Apache Indians soon forced the abandonment of nearly all mines and other enterprises in Coahuila, Chihuahua, and Sonora. All three states were largely, if not entirely, reduced to ruin, and the country was restored to a primitive wilderness under the control of the Indians.

Burden of Taxes Heavier—Difficulties Increase

Taxation had always been a handicap to the industry, and under the new government it became ruinous. According to Cleland[10], the taxes were increased by 1825 to 18 per cent, and by 1868 to 26 per cent divided as follows: assay dues, 6¼ per cent; coinage dues, 4½ per cent; circulation tax, 2½ per cent; export duties, 7½ per cent, and the state tax. The object of these taxes was, of course, to provide public funds, but they were so high and badly or inequitably administered that they defeated their purpose. Smuggling and other means of avoiding them were rapidly developed and continuously applied. Companies which could not avoid them spent most of their profits in paying them and tribute to bandits. The havoc wrought in the industry by these outrageous taxes was realized a short time before the appearance of Diaz upon the political stage, and they were greatly reduced as part of the vain effort to change general defeat to victory.

The situation was further complicated by the constitutional change in 1857, which permitted individual states to legislate upon mining matters. This soon increased the taxes and difficulties of operation. Shipments of bullion could be made only under heavy guard, and rates of exchange between the capital and the interior soon developed.

Natives Exploit Foreigners' Ignorance

The causes of failure from purely economic conditions were of two sorts: the folly and ignorance of the companies, and the physical condition of the country. The companies' ignorance of the true conditions in Mexico and the inability of the natives to mine under the conditions resulted in an abandonment of all native developments in the industry and the introduction of all manner of unsuitable foreign machinery. The transportation of this heavy machinery over specially constructed roads absorbed great sums of money. Expensive and useless development work was pressed without satisfactory investigation of the probable value of results to be obtained. The natives, preying upon the ignorance of the foreigners, bled them freely in leasing contracts and transfers of properties. The utter lack of roads and transportation facilities made the operation of any but high-grade mines impossible, and after three centuries of mining, only small quantities of high-grade ore remained in those mines that had been developed or explored.

French Intervene

Ore, bullion, and supplies were necessarily hauled great distances in primitive carts along wretched roads, or were carried by Indians or mules long distances over rough mountain trails, and the distribution of vital supplies was unequal. These enormous costs soon absorbed all available capital. The country was once more without sufficient funds to build smelters, install proper equipment, and construct proper means of transportation. Mexico was again dependent upon her own resources and for a short time production increased slightly, but then came the second political storm—the French intervention. Again the industry was reduced almost to ruin, and the costly attempt at revival wasted.

General Lew Wallace[11] says, "Santa Eulalia really ceased to be worked in any magnitude when the Spaniards were driven from Mexico. In different ways the mines fell to owners who had little capital and still less energy. They derive aid, however, from others. Thus Señor Mateas has his backers in the city who advance him limited sums—to meet current expense—(and) he not only returns the principal of the loan, but also pays his accommodating friend two-thirds of the profits. Such a system, together with the methods pursued, will keep that excellent gentleman poor though he owned all the mines in Mexico and lives a thousand years."

What General Wallace wrote of the conditions in the famous Santa Eulalia district was largely, if not entirely, descriptive of those which characterized operations in the entire country.

To be concluded.

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[9]This view is contrary to the opinion of T. C. Graham, who states in his interesting article, "The History of Mining Development in Mexico," *Mining World*, Oct. 26, 1907, Vol. 27, p. 704, that:

"It is generally stated that all these foreign companies lost money, principally owing to reckless expenditure, etc., but this is not correct. Certain concerns did wind up their business very much in pocket. Others, generally the larger ones, did not do so; they lasted longer; and as the republic began to count birthdays, it is sad to relate, she did not improve in morals, and internal conditions became bad. Refer to Lord Russell's speeches before the House of Commons on the Mexican claims; it is a list of murdered men and straight highway robbery. The looting of a special train en route for England at Laguna Seca was one of the reasons why Great Britain was party to the treaty of London and the intervention of 1861."

[10]"The Mining Industry of Mexico," p. 639.

[11]"Harpers Monthly," 1867.

Technical Papers

The Geology of the Diamond-Bearing Gravels of the Somabula Forest. By A. M. MacGregor. Geological Survey Bulletin No. 8, Southern Rhodesia.

This bulletin consists of thirty-eight pages and is illustrated by several interesting photographs, a geological map, and several cross sections. Bound with it is a report by A. C. Seward and R. E. Holttum on fossil plants found in the Karroo beds of the deposit.

The report is an important contribution to the geology of diamond deposits. South and Central Africa are preeminently the diamond-bearing regions of the world, but the diamond pipes of Orange Free State and the Transvaal have furnished such a large percentage of the world production of diamonds since 1870, and have been so frequently described, that an impression exists among mining geologists and engineers that they and the placer deposits derived from them are typical of all diamond deposits in Africa.

In reality, diamonds in Africa have been derived from three distinct sources:

First, an unknown but very ancient source which furnished the detrital diamonds yearly recovered by certain of the Rand mines in crushing the Witwatersrand Series (of Cambrian or pre-Cambrian age).

Second, H. S. Harger found in the Vaal River region, two diamonds in fragments of amygdaloidal augite andesite, of the Ventersdorp Series (Early Paleozoic age).

Third, the most important sources of diamonds are kimberlite pipes which occur from the Orange River northward into the Belgian Congo, a distance of 1,300 miles.

Diamonds were first found in Somabula Forest, central Southern Rhodesia, in 1903, and since then the district has been a small producer of diamonds, the total output to the end of 1920 being 13,409⅝ carats, worth approximately £62,000, or $22 per carat. Mining has been carried on largely by prospectors, the operations of the South African Option Syndicate, the only company which has operated in the field, not having been successful.

Somabula Forest lies in a flat country, the boundaries of the forest being coincident with the outcrop of an outlier of Karroo beds. The underlying complex consists largely of granite with feebly developed gneissic structure. At several places it contains ancient schist inclusions, and it is cut by diabase dikes of unknown age. The Karroo beds lie upon the undulating surface of the ancient granite and consist of fluviatile and estuarine deposits which presumably came from the north. Fossil plants found in these flat-lying sedimentary rocks show them to be of Upper Karroo age, and the author correlates them with the Stormberg beds of South Africa, although he is uncertain whether the beds should be grouped with the Forest sandstone or Escarpment grits of other portions of Rhodesia. They consist of two unconformable series, a mudstone group below and an arkose group above. The mudstone group is about 25 ft. thick and consists of fine-grained sandstone and shales of pink or white color. In it are lenses of gravel with a clayey matrix. The arkose group, a recomposed granite, lies upon the slightly aroded surface of the mudstone group and consists of coarse arkoses with lenticular beds of pebbles. The pebbles consist largely of vein quartz, quartzite, tourmaline-bearing quartz schist and granite, but some are of serpentine, chrome iron ore, banded iron stone and jasper. The predominant mineral of the diamond concentrates is staurolite, and, in addition, the following minerals are common: chrysoberyl, corundum, including common corundum, ruby and sapphire, garnet, cyanite, quartz, rutile, and tourmaline, and in addition hydrated phosphates of aluminum and cerium, beryl, chalcedony, chromite feldspar, gold, ilmenite, secondary limonite, mica, osmiridium, and platinum. Topaz and zircon also occur.

The diamonds found to date have been of relatively large size, the average weight being from 0.7 to a little under a carat, although, of course, this unusually large size is in part due to the size of screens used in mining. A great majority of the stones are of faint greenish tinge, which, however, is lost in cutting. A few yellow diamonds are also found and likewise smoky brown stones which grade into bort. It is believed by some that the green color is due to a slight iron stain. The octahedron predominates as a crystal form and dodecahedra and twins are also common. The largest gem stone yet discovered weighed 36¼ carats, but a bort of 50 carats is reported.

The author believes that the original source is a basic igneous rock some distance to the north, probably one of the ancient ultra-basic rocks which have been reported from many places in Rhodesia.

By the disintegration of the Karroo rocks and near-by granite, recent rubble and sand deposits have been formed which contain well-rounded pebbles of agates and silicified fossil tree trunks as well as stone artifacts. These recent deposits are in several places feebly diamond-bearing.

The material mined is the bottom foot or two feet of gravel of the two Karroo formations lying directly upon the granite floor and this material, in instances after it has been permitted to disintegrate, is screened and the minus ⅝-in. and plus ⅛-in. material is treated in rotary pans; the concentrate is thereafter screened in water and hand picked, first wet, and then dry.

Some chrysoberyls of deep yellow color and blue topazes are also recovered, production of these stones to the end of 1920 being 72,977 carats, worth £8,065. Occasionally a nugget of gold is won, and several years ago considerable excitement was caused by the reported presence of platinum metals in the concentrates, but the quantity of the metals present is non-commercial

It has been known for some time that the Congo and Angola alluvial diamonds which year by year are becoming more important, are weathered out of conglomerates at the base of the Lubilashe formation (Jura-Triassic age). There is a marked similarity between the diamond-bearing deposits of the Somabula Forest and the sedimentary beds from which the Congo and Angola alluvial deposits are derived. In each district, andalusite is the most abundant constituent of the concentrates, and the only concentrates reported from Somabula, and not occurring in the Kasai district, are phosphates of the rare earths similar to the "favas" of Brazil, chromite, and the platinum minerals. All of the more common Congo-Angola concentrates are reported from the Somabula deposits. In passing, it may be mentioned that in the Vaal River region in South Africa a few detrital diamonds are reported to have been found in the Dwyka conglomerate of Permian age.

There are, therefore, in Africa two important types of diamond deposits: First, those of the Cretaceous Kimberlite pipes of South Africa, and, second, those derived from a source of considerably greater age, of which the Congo-Angola fields are by far the most important commercially, but to which, in addition, those of the Somabula Forest belong. SYDNEY H. BALL.

The Burma Corporation—The operations of the Burma Corporation in India, which owns a large silver-lead-zinc mine and reduction works, are described at some length in No. 46 of the *Proceedings* of the Australasian Institute of Mining & Metallurgy, for June, 1922 (Collins Court, 374 Little Collins St., Melbourne, Victoria, no price given). The article covers forty-four pages, to which are appended many plates.

Welfare Work—The United States Steel Corporation has issued Bulletin No. 9, devoted to the safety, sanitation, and welfare activities of the various companies. The amount spent for welfare work—from Jan. 1, 1912, to Sept. 30, 1922—totals $108,509,723, and this does not include total pension payments to employees and additional benefit payment and administrative costs.

Drill Steel—*Compressed Air Magazine* for February (11 Broadway, New York City; 35c.) contains Part I of a continued article entitled "Drill Steel and the Drill Steel Sharpener." The author discusses the treatment of drill steel in the blacksmith shop of a big iron-mining enterprise in Michigan, and the article contains much practical information.

Bureau of Mines Publications—The U. S. Bureau of Mines has issued a pamphlet indexing all of its publications to date. Obtainable on request from the Bureau at Washington, D. C.

SOCIETIES, ADDRESSES, AND REPORTS

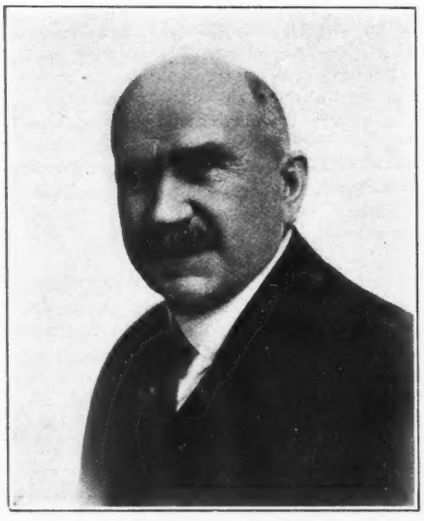
A. I. M. E. Holds Spring Meeting

Engineers Gather Again in New York—Liquid Oxygen Explosives Discussed—Ambassador Caetani Speaks at Banquet —E. P. Mathewson Elected President

STAFF REPORT

MINING and metallurgical engineers gathered once again in New York from Feb. 19 to 22, inclusive, at the spring meeting of the A.I.M.E. to avail themselves of the opportunity it offered to meet one another and exchange experiences. Perhaps no other organization, unless it be the International Explorers' Union, convenes from such widely separated points as does the Institute. Alaska veritably meets Cape Horn on these occasions in the Engineering Societies Building. The affair was a success. The attendance was good, over 830 having registered by the end of the second day. Somehow, most of the sessions started pretty close to the scheduled hour, which, of course, was unusual, not to say unorthodox. Most prominent on the program was the symposium on petroleum and gas. Of the individual papers that by Messrs. Kuryla and Clevenger on liquid-oxygen explosives was the most notable, and of the individual sessions that of the luncheon to members and guests was the most popular—no one missed it, although it was a daily matter. The presence of ladies added the one touch needful to make the *tout ensemble* perfect.

The opening session of the annual meeting was devoted to a discussion of ground movement and subsidence. Although this topic is of greater interest to coal than to metal miners, an interesting and comprehensive paper by J. Parke Channing, "A Study of Subsidence at Miami, Ariz.," showed how carefully subsidence has to be considered by some metal-mining companies. In the words of the chairman, H. G. Moulton, this paper enabled the *Transactions* to include for the first time a thorough study of subsidence and its effects, with valuable records and data. Mr. Channing's paper was an answer to the substance of George S. Rice's paper, presented at a later session, in which he made a plea for recording systematic data upon ground movement. Mr. Rice outlined forms applicable to the making of subsidence records, illustrating his paper with diagrams. Subsequent discussion brought out the fact that the subject is still rather clouded and that many data are desired to explain the phenomena of ground settlement over mine workings.



E. P. Mathewson, newly elected President of the A.I.M.E.

The session devoted to metallurgical papers was held on Monday afternoon. The paper on "Heap Leaching at Bisbee, Ariz.," by A. W. Hudson and G. D Van Arsdale, was read in part by a representative of the authors, who commented on the curious fact that mine water containing ferric sulphate will not dissolve copper to the extent that would be expected considering its ferric sulphate content. A possible reason that was offered was the fact that mine water contains basic salts that deposit on the material to be leached and prevent the solution that would otherwise take place. It was suggested that this was an important field of research, to which hydrometallurgists could well devote some attention.

In the discussion of this paper, R. C. Canby referred to the effect of capillary action which carried the solutions to the surface of the leach heap and permitted it to dry out rapidly. This, he thought, was important. J. Parke Channing spoke of some of his experiences in heap roasting and told of an instance where 2 lb. of copper per ton of ore was mysteriously lost. This loss he attributed to volatilization of the copper.

The paper by J. O. Betterton, on "Soluble Silica in the Preparation of Zinc Sulphate Solution for Electrolysis," was to have been read by Mr. Antisell, but as he was not present the chairman read an abstract. There was no discussion.

"Pyritic Smelting and Basic Converting at the Kosaka Copper Smelter, Japan," aroused more interest than any other paper presented. An abstract of the paper will be published in an early issue of the *Journal-Press*. As published by the Institute much of the detail contained in Dr. Ikeda's original manuscript was omitted and further condensation was made by E. P. Mathewson, who presented it at the meeting.

Written discussion was offered by W. R. Ingalls, who emphasized the large amount of labor required in feeding nut coal into the tuyères of the Japanese furnaces by hand. J. Parke Channing then compared the practice at the Tennessee Copper Co.'s plant at Copperhill with that at Kosaka. At Copperhill, the ore column is about 12 ft. high, compared with 9 ft. at Kosaka. The furnace charge at the Tennessee plant is made up of Burra Burra ore, quartz, and coke, and 1,000 tons of the ore is smelted per day in a 56-in. x 32½-ft. furnace, using 4 per cent coke. The ore is coarse, containing pyrite and pyrrhotite, and contains about 25 per cent sulphur and 15 per cent silica. The purpose is to make a furnace gas high in sulphur dioxide and low in carbon dioxide, acid making being the primary consideration rather than copper smelting. The blast-furnace gas therefore carries about 7½ per cent sulphur dioxide and 2½ per cent carbon dioxide, normally. Blast is furnished by two Nordberg engines, each of 30,000 cu.ft. capacity. The matte at present averages between 10 and 11 per cent copper; the grade could be improved by adding more quartz and some lime, but it is not economical to do so. The slag runs 36 per cent silica and at least 0.3 per cent copper.

Several years ago, according to Mr. Channing, nut size coal was tried in the tuyères of the blast furnace, but the labor cost was too great. Later powdered coal was tried, but its use was discontinued, and there is a good deal of mystery as to how well it worked.

It is suspected that some of the night shifts, fearful of a freeze-up, would occasionally put coke on the charge, but it was pretty well proved after the experiments had continued for some time that smelting could be carried on satisfactorily with powdered coal as fuel, introduced through the tuyères. The innovation was finally abandoned because some of the coal particles, passing into the gas, made the acid black, to which the fertilizer company buying it objected. Black acid is thought to be as good as any other color for fertilizer manufacture, but the necessary missionary work among the fertilizer manufacturers was apparently not done. Mr. Channing thought that nut size coal might not have this disadvantage, and mentioned the use of coal in Scottish iron blast furnaces. This was evident from the fact that a byproduct known as blast-furnace oil was sold in large quantities, and makes an excellent flotation oil, as attested by its use at Miami. It was also brought out by another contributor to the discussion that in Jackson County, southern Ohio, some furnaces are using as much coal as coke in the charge.

A new 13x30-ft. Peirce-Smith converter has just been put in operation at Copperhill, and experiments are being made on the smelting of large quantities of flotation concentrate in the converter, it being introduced with the Garr gun. The converter slag averages 16 per cent silica, and is poured in the blast-furnace settlers, thereby increasing the slag loss between 0.01 and 0.02 per cent of copper. Exit gases from the converters average about 7½ per cent sulphur dioxide and are used to make acid. Japanese practice is evidently to make a 25 per cent blast-furnace matte and then to concentrate it to 37 per cent by re-smelting.

E. P. Mathewson spoke of the introduction of powdered-coal firing at various plants. At Midvale, Utah, 33 per cent of the coke used in the lead furnaces had been displaced by powdered coal introduced through the tuyères. A greater proportion of coal slowed down the furnace. Better reduction of oxidized material was also mentioned. All in all, about $1,000 per month per furnace is saved by using coal at the Midvale plant. The A. S. & R. has been also tried the innovation at Garfield, finding a 33 per cent substitution satisfactory, but permanent coal-burning apparatus was not installed for the furnaces because the investment was not thought justified, considering the minor part that blast-furnace smelting was expected to play in future. At Copper Cliff, the International Nickel Co. had carried out promising experiments that were stopped when the plant was closed down. At Cerro de Pasco, the new smelter is equipped for powdered-coal burning in the blast furnaces, and is reported extremely successful. Some metallurgists are reported to have been discouraged by the fact that powdered-coal firing was not continued at Tennessee, where it was developed.

Mr. Mathewson thought that coke might be better than coal in that it would not have so much of a tendency to slow up a furnace when used in large quantities. Also, that broken coke or coal might be better than the powdered article, and that means could no doubt be devised for mechanical feeding, so that the large labor requirements of the Japanese practice could be dispensed with.

A paper entitled "Relative Efficiency of Amalgamation and Cyaniding," by Allan J. Clark and W. J. Sharwood, was read by title only, it consisting largely of two pages of tabular matter. No comment was offered.

Mining Methods Discussed

Some of the most interesting papers presented at the annual meeting were read in the mining sessions. These papers covered mining methods used in Michigan, Idaho, Arizona, Montana, Utah and Colorado. William Kelley read a paper by S. R. Elliott and associates on "Mining Methods at Marquette Mine," and was followed by an interrogation by various Institute members requesting details. George W. Roddewig, in the afternoon session, presented an article describing the Bunker Hill & Sullivan methods of mining, written by H. M. Childs and Stanly A. Easton. W. H. Schacht asked several questions regarding the conditions under which actual extraction of the ore took place.

The next paper, of a strictly geological nature, entitled "Economic Application of Zonal Theory of Primary Deposition of Ores," was presented by its author, John Carter Anderson. It emphasized the application of this theory to a particular mine in Arizona, the Magma, and showed how closely theory and results were related. Professor Kemp contributed to the discussion and outlined the early work on the theory and the limitations to its application. He especially cited the California Mother Lode deposits as probably falling outside the scope of this theory. The "Magnetic Methods of Exploration and Geologic Work," by W. O. Hotchkiss, were explained by Mr. Dickerman.

Mining methods of the Hecla Mining Co., by J. F. McCarthy and C. H. Foreman, were read by title. G. W. Roddewig presented a comprehensive and extremely interesting description of mining methods in the Butte district. This paper was prepared with the co-operation of the many mining companies working in Butte which in a typical Butte spirit gave wholeheartedly many data regarding their operations.

A lucid paper describing the mining methods in the United Verde district was read by title owing to the lateness of the session. Mr. Mathieu prepared a paper on the driving of the Rove tunnel, which was read at the meeting, and described in great detail the system of tunneling used, costs and other engineering data. Prof. R. M. Raymond made a report on a "Classification of Nomenclature," with regard to methods of ore mining, which was prepared for use with the papers on mining methods. A complete classification will be prepared later. Frederick Burbridge contributed a paper on "Mining Methods of the Morning Mines" which was read by title, and C. E. Van Barneveld discussed the subject of "Mechanical Loaders at Underground Mine."

At the mining session on the morning of Feb. 21, which was presided over by George W. Packard, the most important paper of the entire meeting was presented. This was the exhaustive treatise on "Liquid Oxygen Explosives at Pachuca," by Michael H. Kuryla and Galen H. Clevenger. In the discussion which followed, various points were brought up by a representative of one of the powder companies, which were satisfactorily answered by Mr. Kuryla, who presented the paper.

Three interesting papers on mining methods were presented. The first was entitled "Development and Extraction Methods for Lake Superior Copper Deposits," by F. W. Denton, vice-president of the Copper Range Co. In concluding the author stated that the conditions under which the development and extraction must be done, as he had outlined, could only be considered as highly favorable for low costs. Now that four or five hours was sufficient for doing all the drilling required before blasting, it would seem that the time had come, he said, when three shifts per day could be used and the rate of extraction much increased, to the benefit of the leaner mines. When to all these advantages are added those outside of the mine, such as cheap milling, with an extraction of 85 per cent and better, and a concentrating ratio of 30 into one, and cheap smelting, there was nothing to fear, in his opinion, for the future of the district.

"Mining Methods of the Miami Copper Co.," by J. H. Hensley, Jr., was outlined by B. Britton Gottsberger, formerly general manager of the company. In this paper voluminous data regarding the operations of the Miami company were presented.

W. Spencer Hutchinson gave a brief outline of the points covered in a paper by Fred Jones, of Victor, Colo., on "The Mining Methods of the Cripple Creek District." This paper had been previously discussed at the local section in Colorado.

The outstanding point made at the drill-steel-breakage session was that many mining companies are groping in the dark over the methods to be used to obtain more satisfactory sharpening and durability of drill steel. The researches of Messrs. Foley and Clayton during the last summer, as presented in a review of the present status of drill-steel breakage and heat treatment, showed a wide divergence of practice among about sixty mines visited. Mr. Foley advocated the publication of a primer in which simple elementary heat-treatment principles could be stated for the edification of mine blacksmiths. R. G. Wayland, of the Homestake Mining Co., in a written discussion, gave records and curves plotted from observations of drill-steel breakage at the Homestake. Steel generally broke behind the bit. Mr. Schacht, manager of the Copper Range Co., contributed to

the discussion and stated that quality should be the first consideration in the selection of a drill steel. He said that lack of clearance was an important cause of breakage and, when ample, reduced breakage by half. Arthur Notman recorded his impressions from drilling experience in the Southwest.

Industrial Relations and Safety Work

Three sessions of the Industrial Relations Committee, of which Robert Linton is chairman, showed substantial work during the year by eight subcommittees. Reports were submitted on the following: Americanization, Cripples in Industry, Education, Employment, Housing and Recreation, Mental Factors in Industry, Prevention of Illness, and Safety.

The last two sessions were held jointly with the mining section of the National Safety Council. Safe equipment for mine hoisting plants was the first subject considered. A comprehensive paper by Rudolph Kudlich was followed by R. L. Sanford, of the U. S. Bureau of Standards, who told of plans for developing a method for scientifically determining the safe or unsafe condition of a hoisting rope without injuring it and without removing it from service.

The prevention and fighting of mine fires was the subject of two excellent papers. B. F. Tillson, superintendent for the New Jersey Zinc Co., described the installation of fire-fighting equipment in the mines of his company at Franklin, N. J., and George S. Rice, of the U. S. Bureau of Mines, outlined his ideas of effective safety orders for regulating work in the prevention and control of mine fires. These papers were discussed critically by a number of engineers. Two papers on industrial relations by J. N. Hauser and H. L. Mead, and one on "Industrial Psychiatry," completed the program.

Petroleum Sessions Well Attended

A symposium on petroleum and gas was one of the important features of the program. The topic was "Developments During 1922," and remarkable success was achieved in bringing together a large number of papers describing what had been done in the various fields in the United States during the last year as well as abroad. Ralph Arnold presided.

In discussing the paper presented on California, Mr. Arnold said that, in the new fields recently opened up, three zones had been developed, any one of which would be considered good. One of these fields was opened in territory already divided into town lots, with the result that five wells had been drilled to an acre, where a conservative policy would have meant the drilling of one well to five acres.

E. De Golyer discussed developments in Mexico, where, he said, 180,000,000 bbl. was produced in 1922, or 14,000,000 bbl. less than in 1921. Exports in the same year equaled production, and stocks had been drawn on for 10,000,000 or 11,000,000 bbl. The drop in production was entirely in light crude and was offset by an increase in the heavy crude output. At the beginning of the year light crude had constituted four-fifths of the total, but was only three-fifths at the end, due to salt water invasion in the Toteco-Cerro Azul field. The light crude oil production is important in its effect upon prices in the United States. During the year Mr. DeGolyer said 209 wells had been completed, of which 166 were failures. What was chiefly required today, he said, was a sane conception of Mexico's position as an oil producer. The staying power of wells in which salt water had appeared had been underestimated, and he gave figures to support this statement. Mexico had always suffered, he said, because wildcat drilling had not kept pace with new production. In concluding, he said that Mexico was no longer a menace to the American producer, though new fields might be discovered.

An entire session was given to the consideration of development in foreign fields. V. F. Masters and Stanley Harold presented papers on Peru and Argentina respectively. J. W. Lewis' paper on developments in Venezuela was read in his absence. In this he endeavored to answer various questions that had arisen since the Santa Rosa gusher was brought in Dec. 14, 1922. He said that the immediate object of almost every company operating in Venezuela had been to acquire and prove oil reserves and not to produce oil and that therefore the potential production and reserves required and not the present production were the gage of success of operations. Up to the time this gusher came in, the Mene Grande had been the only region that justified exportation. He discussed briefly the number of producing and drilling wells and well locations reported up to December 1922. The Santa Rosa well and the La Paz well had been developed in areas not considered particularly desirable from a geological standpoint. The greatest significance thus lay, it was said, in the light thus thrown on the possibility of similar areas that were lacking surface evidence of promise and far from the foot hills. The deeper sands of none of the fields have been tested.

Developments in Colombia during 1922 was discussed in a paper by Joseph H. Sinclair and Edwin B. Hopkins, the former presenting the paper. Colombia, it was said, would doubtless be listed as a producer in 1923. Up to the present only three South American countries had appeared as producers of petroleum, these being Peru, which attained a yearly production of 3,700,000 bbl. in 1921; Argentina, which produced 1,747,000 bbl. in that year; and Venezuela, which had produced in the same year about 1,400,000 bbl. The paper was limited to a description of operations of companies which had drilled for oil during 1922. The paper described the drilling operations of twenty-three wells during 1922 and the latter part of 1921. Previous to this about twenty wells had been drilled in Colombia, mostly in the coastal region along the Caribbean Sea, this making a total of forty-three wells drilled or drilling so far. Of this number, it was said, four were commercial producers yielding 2,300 bbl. per day. Leaving out these four and the nine wells now drilling, there was a total of thirty wells that had been abandoned on account of failure to get commercial amounts of oil or for mechanical or other reasons preventing complete tests. The authors stated that in view of the large area of sedimentary rocks in Colombia and the fact that only about three localities had so far been fairly well tested, it was evident that no conclusion should be drawn from the high percentage of unsuccessful wells drilled. Furthermore, drilling so far had been limited to certain lines because of the unfavorable nature of the Colombian petroleum law.

Two papers by Arthur H. Redfield discussed petroleum developments in Central America and in the West Indies respectively. Crude oil was produced commercially in but two of the islands exclusive of Trinidad—namely, Cuba and Barbados. Central America, the anthor said, might be regarded as an undeveloped field, drilling having taken place only in Honduras, southeastern Costa Rica, and in Bocas del Toro Province, Panama. A geologic exploration occurred during 1922 in Guatemala, Nicaragua, and El Salvador. For the rest, the chief activity was confined to lease hunting. The Sinclair Consolidated Oil Corporation through its subsidiaries was the only company actively drilling in Central America.

Progress of the petroleum industry in Europe, Asia, and Africa was outlined in a notable paper by Henry C. Morris and David G. White.

The symposium concluded with a session devoted to the consideration of technical subjects. The action of mud-laden fluids in wells was discussed in a valuable paper by Arthur Knapp. The subject, according to Mr. Arnold, the chairman, was one of the most important problems in the industry today. Several of those present took part in the discussion which followed, in the course of which Mr. Knapp supplemented his paper with further data. A paper by Thomas Cox entitled "Relations of Bonuses and Costs to Present-Day Prices of Crude and Its Products" was presented by title. In the discussion of it a plea for more data on costs was made. The work such as Mr. Cox was doing, said Mr. Arnold, showed why so many companies were unsuccessful in their operations. Another paper describing the Sunburst Oil and Gas Field in Montana, by Dorsey Hager, was read by F. G. Clapp. At this session, also, Mr. Arnold described briefly the developments that had taken place in Canada during the past year, to which Mr. Clapp had further information to add. "Oil Development on the Isthmus of Tehuantepec" was presented by Stirling Huntley.

Annual Business Meeting

The retiring president, Arthur S. Dwight, presided at the annual meeting of the "stockholders," as he called the members, at 9 a.m. Tuesday morning. The formal reports of F. F. Sharpless, as secretary, and of Charles F. Rand, as treasurer, have been published in bulletin form and can be had by members on request. In his brief farewell address Mr. Dwight declared that the finances of the Institute are in better condition than for some years. During the year $174,479 was disbursed and the budget for the coming year totals about $200,000. Mr. Dwight commented at some length on the Institute publication *Mining and Metallurgy*. He declared that the monthly magazine was justified, first, because it was the only practicable medium for holding together the widely scattered membership and keeping it in touch with headquarters in New York; and second, because it ultimately would be a source of profit, and the Institute was in need of additional income if its activities were not curtailed. He was particularly emphatic in his commendation of Mr. Sharpless for his untiring and conscientious efforts and for the tactful way in which he had met numerous trying situations. The tellers' report showed the election for the ensuing year of the following officers, with only a few scattering votes in opposition: For president and director, E. P. Mathewson; for vice-president and director, T. T. Brewster and Frank M. Smith; and for director, W. H. Aldrich, G. H. Clevenger, A. N. Diehl, Reno H. Sales, and Seely W. Mudd.

Smoker and Banquet

Those fortunate enough to be at the smoker on Monday night were thrilled by an account of Captain Walter E. Traprock's adventures in the Far North, which was given by the noted explorer himself. Captain Traprock, who is a member of the South Seas Explorers' Union, told how, after his discovery of the Filbert Islands, he followed up this achievement by re-discovering the North Pole, incidentally taking his entire party, ship and all, directly to the Pole, over the ice. "Jack" Armour, *Power's* well-known raconteur, then enlivened the evening, which otherwise might have been a serious occasion, by a fund of stories rivaling those of Irvin Cobb. Other features of the program included community singing and, of course, the usual refreshments.

The annual banquet was held on Wednesday evening at the Waldorf Astoria. The Italian Ambassador, Prince Gelasio Caetani, the guest of honor, was the principal speaker. The use that he made of the Brunton compass during the war, when he directed the famous operations at the Col di Lana was an interesting item of his speech.

On Thursday, Feb. 22, a party visited the plant of the American Brass Co. at Ansonia, Conn., on the invitation of that company.

MEN YOU SHOULD KNOW ABOUT

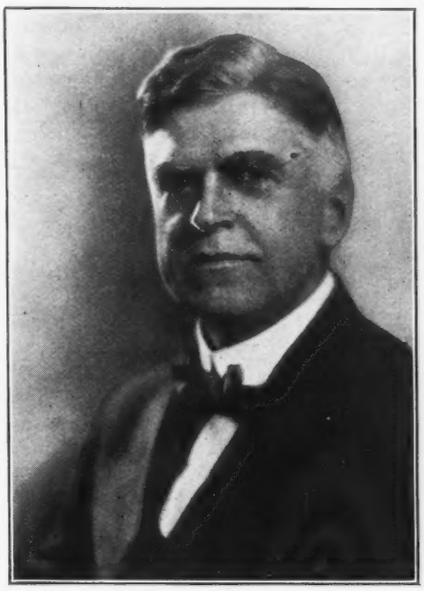
F. W. Bradley is at Washington, D. C.

D'Arcy Weatherbe has returned from Pekin, China, to Rotherham, in Yorkshire, England.

Oscar S. Hershey recently stopped in Reno, Nev., en route to San Francisco from Butte, Mont.

H. J. Sheafe has taken the position of general manager of the Argonaut Mining Co., at Jackson, Calif.

Ronald McKinnon, Imperial Oil Co. official in charge of transport at Fort Norman, has arrived at Edmonton.



George S. Rice

George S. Rice, the chief mining engineer of the U. S. Bureau of Mines, has been selected as the Bureau delegate to attend the Mining Exposition and Conference which will be held in London, June 1-14. He will sail from New York on May 12. Following the exposition he will visit other countries of Europe to continue his study of mining methods. He also will devote a considerable portion of his time to a study of the improvements made in the manufacture and use of liquid oxygen.

R. L. Chase, of Dnver, is making trips to New York and Indianapolis on business connected with his mining interests.

Henry Wyman, of Cedral, and **D. B. McAllister,** of Catorce, Mexico, have left for Cananea, Sonora, on professional business.

H. C. George, of the U. S. Bureau of Mines, stationed at San Francisco, has been assigned to the Bartlesville station of the Bureau.

S. F. Shaw has been appointed manager of the Cia. Minera Nazareno y Catasillas, in the Mazapil district, Zacatecas, Mexico.

D. L. H. Forbes, general manager of the Teck-Hughes gold mine, Kirkland Lake, has been appointed general manager of the Orr mine.

W. H. Blackburn, general manager of the Tonopah Mining Co. and allied properties, has gone to Cripple Creek, Colo., to direct reopening and exploration work in the Ajax mine.

C. Le Roy Olson has resigned as mill superintendent of the Kansas City-Nevada Consolidated Mines Co., and is now affiliated with the Sierra Magnesite Co., of Porterville, Calif.

John U. Sebenius, general mining engineer; **G. E. Diehl,** assistant general engineer; **George A. Fay** and **A. E. Anderson,** engineers, all of the Oliver Iron Mining Co., at Duluth, are making a trip through the fluorspar districts of Kentucky.

Dr. Eliot Blackwelder was recently entertained by graduates of Stanford University at the Engineers Club of San Francisco. Dr. Blackwelder succeeded Dr. Bailey Willis, who resigned the chair in geology at Stanford University.

James F. Kemp, professor of geology at Columbia University, will go to Porto Rico late this month to make a survey of the mineral resources of the island for the New York Academy of Sciences. He will also assist in a reconnaissance of the Virgin Islands preparatory to detailed geological investigations.

Dr. J. C. McLennan, of the University of Toronto, who recently succeeded in liquefying helium, will visit the most important laboratories of Britain, France, and Holland, returning to Canada in September for the meeting of the British Association for the Advancement of Science.

Lloyd L. Root has been appointed State Mineralogist of California by Governor F. W. Richardson. Mr. Root was graduated from the Mackay School of Mines, at Reno, Nev., in 1916. Since then he has been superintendent of the Candelaria mines, in Mexico, and was manager of the Alcalde, which is a small mine in the Grass Valley district. He is thirty-one years old.

Dr. Walter Rosenhain, superintendent of the metallurgical department of the National Physical Laboratory, at Leddington, England, gave two addresses at the Carnegie Institute of Technology, at Pittsburgh, on Feb. 12 and 13. On the first occasion his subject was the laboratory at Leddington, with some of the results; the second subject dealt with strains and fractures.

F. W. McNair, president of the Michigan College of Mines, at Houghton, has been appointed by Secretary Hoover a member of the board of visitors of the United States Bureau of Standards for a period of three years. Other members are: **Dr. Ambrose Swasey,** of Cleveland; **Dr. John R. Freeman,** consulting engineer, of Providence, R. I.; **Prof. Wilder D. Bancroft,** of Cornell University, and **Dr. Samuel W. Stratton,** formerly director of the Bureau and now president of the Massachusetts Institute of Technology.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

THE New Cornelia Copper Co. has placed orders aggregating $2,000,000 for machinery to be installed in its new concentrating plant at Ajo, Arizona. Construction work is in progress.

The new 2,500-ton concentrator of the Britannia Mining & Smelting Co., on Howe Sound, in British Columbia, has been put in operation.

Tests show the unquestioned advantage of using 1¼-in. dynamite instead of smaller sizes.

The mining of manganese-iron ore has been resumed at Silver City, N. M.

Expansion of operations at Bisbee gives employment to many more men.

An investigation of health conditions in the mines of the Tri-State zinc-lead region has been instigated by increase in tuberculosis among miners.

Official announcement is made of the starting of construction work on the Granby mill, at Anyox, B. C.

The Colorado Legislature has memorialized Congress in regard to "silver" legislation.

The Southern Manganese Corporation is criticized by War Minerals Relief Commissioner for imposing on government. He awards part of claim, however.

The Chief Consolidated Mining Co. in Utah was the largest producer of silver in the United States in 1922; output was 3,768,390 oz.

Bisbee District Brightens Perceptibly as Operations Expand

Phelps Dodge and Shattuck & Arizona Employ More Men—New Mill Will Get Steam-Shovel Ore

By Our Special Correspondent.

With the resumption of steam-shovel operations by the Copper Queen interests at Sacramento Hill and the announcement that the Shattuck & Arizona Copper Co. is also to resume work, the Bisbee-Warren district, in Arizona, is resuming its former air of prosperity.

The first blasts have already been sounded from the big hill, and the steam shovels on many of the benches are being made ready for mining the ore that is to supply the new 5,000-ton concentrator near Warren. Workmen are busy getting the finishing touches on the mill, and it is expected to be ready for operation soon. Arthur Crowfoot, superintendent of the Phelps Dodge concentrator at Morenci, is to be transferred, when the mill is ready to start, and will have charge of its operation. About one hundred men are now at work at Sacramento Hill, making ready for the mining. There are two churn drills and a steam shovel in operation. P. G. Beckett, general manager of the Phelps Dodge Corporation, has stated that the plans of the corporation call for the employment of about 1,500 additional men, which will be necessary in connection with the mining and reduction of low-grade ores of Sacramento Hill. Production of the Copper Queen smelter, at Douglas, is now near 10,000,000 lb. per month, and this will be materially increased when the output of the new concentrator begins to reach Douglas. The present supply comes from Bisbee, Morenci, and from the Phelps Dodge properties at Moctezuma, in Mexico, as well as from customs shippers.

Operations have been resumed at the Shattuck & Arizona copper mine, which had been shut down for the last two years. L. C. Shattuck, general manager, says that the first mining will be done on the high-grade lead ores on the second, third, and fourth levels, and it is expected that production from this source will soon reach 75 tons per day. It is planned to continue this schedule for about thirty days with a force of fifty men, when the mining of the copper ores will be started and more men employed. Joe Walker, for many years foreman at the Shattuck mine, will be superintendent, and C. Peterson is to be master mechanic. About 900 men are employed at present at the Calumet & Arizona mine, which has been producing regularly for many months.

The Ivanhoe Copper Co., under the management of M. J. Elsing, is continuing the sinking of its shaft at its property near Warren. This is a newly organized company owning about 200 acres of patented ground, with many favorable outcroppings. It is planned to start drifting at a depth of 400 ft.

The Denn-Arizona Copper Co., which was shut down in November, 1920, has entered a promising body of sulphide ore on the 1,800 level. It is also expected to resume development soon. The Wolverine & Arizona Mining Co., which own 152 acres adjoining the Copper Queen and the Calument & Arizona Mining Co.'s properties, has a small number of men employed, but plans for the future will require a force of about 100 men.

Increase of Tuberculosis Among Miners Will Be Investigated

Underground Workers in Tri-State Zinc Fields Affected—Change Houses May Help

BY P. R. COLDREN

A general health and sanitation survey of the Joplin-Miami mining field is to be carried out by experts from the U. S. Bureau of Mines. Notice to this effect was received by Richard Jenkins, secretary of the Tri-State branch of the American Zinc Institute, on Feb. 13. It is understood the survey will be made soon. It is the result of efforts by the Zinc Institute and the Tri-State branch of the American Mining Congress to get a scientific examination of the Oklahoma zinc mines, as to whether they are sanitary or are developing tuberculosis, as took place so extensively in the mines in the older camps in the district. Since the introduction of the water-drills it has been believed tuberculosis has been definitely lessened, but recent developments in the Oklahoma section of the field has seemed to show a steady and inexplainable increase in tuberculosis.

A bill introduced in the Missouri Legislature would require coal-mining companies to install shower baths in change houses. The measure would likely have been permitted to die in committee had not representative H. A. Wolcott, of Carthage, pointed out that Jasper County has had to erect an expensive tuberculosis hospital because of the prevalence of the disease, resulting, it is believed, largely from the fact that miners in the zinc mines would walk home in wet clothing after their day's work.

New Britannia Mill Starts on Howe Sound, B. C.

Modern Concentrator Has Capacity of 2,500 Tons per Day—Jig and Flotation Concentrate Made—Details of Flow Sheet

By Robert Dunn

THE Britannia Mining & Milling Co. once more is among the copper producers of British Columbia. The new 2,500-ton concentrating plant, one of the finest of its kind in the West, was started in the middle of February. After a period of inactivity, as far as actual shipping is concerned, the mine is on its feet, and a steady stream of copper concentrate may be expected to flow from Howe Sound to the refineries south of the international line.

Slightly over a year ago fire and flood destroyed the plant of the company. The disaster did not cause a cessation of work; activity was, as a matter of fact, intensified. Not only was a new Britannia mill designed and built, but a new mine, with new and larger ore reserves, was developed.

The following features of the method of treatment are noteworthy:

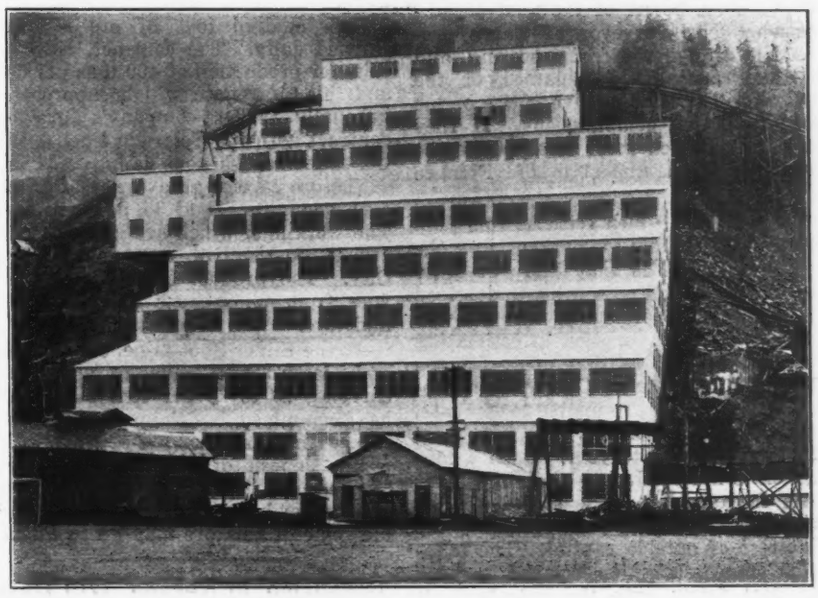
The upper floor is placed at a slightly lower elevation than the portal of the main haulage adit, known in the mine as the 4,100 level, it being about that distance vertically below the outcroppings on the Fairview mineral claim, from which the levels in the mine are numbered. This main haulage adit is about 4,900 ft. long, 13 ft. wide by 9 ft. high, and is connected with the mine workings on the 2,700 level by an inclined rock-raise on a 65-deg. slope, 1,488 ft. high. This raise was finished in November last, and everything is in readiness for haulage operations by this route, which supplants the incline tramway from the 2,700 level to the ore bunkers at Britannia Beach.

The mill is designed so that the ore from the mine, broken in the crusher plant in the mine to pass a 2½-in. ring, will be hauled in cars of 20-ton capacity through the main haulage-adit and delivered into ore bins on the top of the mill, into five bins, each having a capacity of 500 tons. From these bins the ore passes through feeders to a collecting conveyor, equipped with a magnet, and on to two Hummer screens, from which the undersize, ¾ in. or less, is carried to the lower level of the mill, and by a cross-conveyor to a belt conveyor equipped with a tripper into five ore bins, each having a capacity of 750 tons. From these bins the ore is carried by belt conveyors to a weightometer, and from it into an automatic sampler. From the sampler the ore passes on to three Hummer screens, from which the undersize passes into Dorr classifiers, of which there are eighteen. The oversize from the Hummer screens passes into six Hancock jigs, from which the concentrates are discharged into a dewaterer; from there to an automatic sampler, which discharges the discard on to a belt conveyer connecting with a weightometer, from which the concentrate is carried to the jig concentrat-bin in the mill building ready for shipment.

Of the undersize from the first set of Hummer screens which passes into the Dorr classifiers, the sand is discharged into eighteen tube mills, each 7 x 10 ft. From these mills the sand is returned to the Dorr classifiers, the overflow from which, together with the overflow from the dewaterer following the jigs, as well as from the jigs, is conveyed to the flotation cells. From these cells three products are made: concentrate, middling, and tailing. The concentrate is conveyed to an automatic sampler, from that into three Dorr thickeners; thence into two vacuum filters, which discharge on to a belt conveyor connecting with a weightometer. It is conveyed to the flotation concentrate bin in the mill ready for shipment; the middling discharged from flotation cells is conveyed to an air lift and returned to the cells for further treatment; the tailing from the cells is conveyed to an automatic sampler, sampled, and discharged to the waste dump.

Returning to the top of the mill to the Hummer screens, the oversize discharged from the Hummer screens passes into a set of 72 x 20-in. rolls; then on to belt conveyors, by which it is conveyed to Hummer screens, from which the undersize is conveyed to the lower part of the mill, where it is treated in the same manner as the undersize from the first set of screens. The oversize from the second set of screens is conveyed to four sets of 54 x 20-in. rolls, from which the product is carried back to the belt conveyors which follow the set of 72 x 20-in. rolls.

The bunkers on the shipping wharf that have been used in the past from which to load concentrate into vessels are abandoned, and in their place the jig- and flotation-concentrate bins in the mill will be used for storage bins, which will be connected with the hold of a vessel at the wharf by a belt conveyor about 2,000 ft. long. This arrangement removes all danger from fire to the wharf bunkers, which has always been a source of anxiety.



Britannia mill, Britannia Beach, B. C.

Locomotive Firebox of Copper Expensive but Economical, Makers Hope

The Copper Range railroad, owned by the Copper Range Copper Co., in the Michigan copper district, has constructed in its shops a copper firebox for one of its largest locomotives, using 22,500 lb. of copper. The size of the box is 10 x 3½ ft. The firebox sheet is of copper one inch in thickness, and the inside wrapper sheet, five-eighths of an inch. The box has 365 two-inch copper flues. The weight of copper used in construction was as follows: 365 flues, 15,600 lb.; crown sheet, 5,300 lb.; door sheet, 800 lb.; stay bolts, 800 lb.

It is probable more of these fireboxes will be built. They are considered to be more economical in the long run, both in point of fuel consumption and permanence. Heat action is quicker and there is no corroding of flues, thereby assuring long life.

Gold Output in Transvaal

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, Feb. 17.—The output of gold in the Transvaal during January was 764,469 oz.

British Columbian Mine Operators Discuss Mine Taxation With Officials

Depletion Allowance Difficult Question —Taxing Authorities Desire To Be Fair

A desire to take every reasonable step toward assisting the development of the mining industry of the province, while at the same time safeguarding the interests of other tax payers, was expressed by officials of the British Columbian Taxation Department at a conference just held with representatives of the Mine Owners' Association of British Columbia. The owners were represented by Messrs. Clapp and Young, of the Granby Consolidated Mining & Smelting Co.; Mr. Browning, of the Britannia Mining Co.; Mr. Bingay, of the Consolidated Mining & Smelting Co.; Mr. White, of the Silversmith Mines, Ltd.; and Mortimer Lamb, secretary of the association.

At present the Minister of Finance is given the power of the final adjudication. The Surveyor of Taxes proceeds with the work of assessing, and in due course the companies, or the operators, affected receive notice of the results of his computations. If they are not satisfied there is available the recourse of an appeal to the Finance Minister.

Many mining men criticise this plan from various angles, but perhaps the chief objection is that there seem to be no fixed and generally understood regulations under which the taxation department can function in estimating such allowances as that made for the depletion of a mine. Consequently, operators say they are unable to estimate, and make provision for, their provincial taxes from year to year. Such a condition is not conducive of stability. It has the tendency, it is stated, to discourage rather than to stimulate the interest of outside capital. The taxation department has declared its wish to deal fairly with the industry. It asks only that the producing mines pay their proper proportion of the financial burdens of the country, having regard for what is collected from other forms of industry and from citizens generally. As mining of minerals involves the exploitation of the country's natural resources for the gain of one or more individuals, and as what is taken is irretrievably gone, it is maintained that the state is justified in exacting an equitable tax on production earnings.

Capital is entitled to expect that it be permitted a fair rate of interest and that, when the ore reserves of the mine in which it is invested are exhausted, the original outlay, together with interest, shall have been returned. Given a knowledge of the total investment, and accurate information as to the reserves and the returns from the same, and the figuring of a proper allowance for depletion is but a matter of rudimentary mathematics. This ideal condition, however, is found in few if any of the mines of this province. In what class are the mines of the Slocan, for instance, to be put? Some of these have been abandoned by the owning companies, leased with or without option to purchase to enterprising miners; a rich stringer has been worked and several carloads of high-grade ore shipped to the smelter. How is an allowance for depletion to be arrived at in such cases? And there are many properties with regard to whose ore reserves little is known. As a matter of fact, almost every one of the producing mines of the province seems to present an entirely distinct and separate problem for the assessor and the tax collector.

Manganese Mining Resumed at Silver City, N. M.

The shipment of manganiferous iron ores from Silver City, N. M., to Pueblo, Colo., has been resumed. The contract is held by the Benperce Mining Co. B. D. Goodier is manager and Edward Perrault is superintendent of the operations.

One hundred tons of ore is being shipped daily. The contract, however, calls for production of 400 tons per day, and this aggregate will be approached gradually. The company's previous contract with the Colorado Fuel & Iron Co. called for 300 tons daily.

The ore carries an average of 15 per cent manganese and 35 per cent iron. The workings, which are all open cuts, are on Boston Hill, overlooking Silver City. The product is almost entirely free from phosphorus and is low in moisture.

At the Silver Spot mine, on the slope of Boston Hill, manganiferous ore carrying 20 to 23 per cent manganese has been mined, but the property is now idle. Three miles north of Silver City a fine deposit of manganese carrying 35 per cent of this metal and practically no iron has been opened up. It is possible some of this ore may go to Pueblo.

Bellehelen, in Nevada, Will Have $125,000 Mill

The camp of Bellehelen, about 50 miles southeast of Tonopah, Nev., has taken a new lease on life. Small mines were worked in a desultory fashion by leasers for several years, the ore being shipped to the Tonopah mills for treatment. Finally they were closed down because the grade was too low to stand the high haulage and treatment costs. Now the old Bellehelen mine has been absorbed by a new organization known as the Bellehelen Merger Mines Co. This company is going ahead with plans to construct a 100-ton milling plant to cost $125,000. The property taken over by this organization is the only developed mine in the district, and is reported to have $1,000,000 worth of ore blocked out which will average over $30 per ton. Many other adjoining groups of claims are under option, and it looks as if Bellehelen is due for a small boom as soon as the snow clears away sufficiently to permit resumption of travel to and from Tonopah, which is the nearest supply point.

Development Reveals Ore in Mines of Libby District, in Montana

Power Plant, Nearing Completion, Will Facilitate Operations—Ores Contain Lead and Silver

The New Victor-Empire Mining & Milling Co. and the Silver Mountain Mining Co., operating in the Libby district, in Montana, have been installing a joint power plant this winter. The plant will be in operation by March 1. The Victor-Empire tunnel is in 1,575 ft. and is now in a shear zone. The operating officials feel confident that by crosscutting this zone they will find a good oreshoot. Stringers of ore which look encouraging have already been uncovered.

On the Silver Mountain property, tunnel No. 1 is in about 175 ft. and there is a showing of about 6 in. of ore almost all the way; tunnel No. 2 is in about 200 ft. and it shows from 6 in. to 4 ft. of mill ore for a distance of about 75 ft. The operators are at present driving tunnel No. 3 and are in about 200 ft., but have not yet got under the shoot.

The Mountain Rose property is being operated with air drills, the compressor being driven by a gasoline engine. Recently, stringers of ore which assay 75 oz. in silver have been cut. The crosscut is in about 200 ft.

The Treasure Mountain and Double Mack companies have been idle for several months, but the management is considering development in the spring, the difficulty being the obtaining of funds in quantity sufficient to finance work on a scale that is considered worth while.

The Victor-Empire and the Silver Mountain are on the same lode on opposite sides of Granite Creek about 11 miles out of the town of Libby; and the Mountain Rose and the Double Mack are on the same zone a short distance east of the other properties and on opposite sides of the creek also. The Treasure Mountain is on Horse Creek and joins the Victor Empire on the north.

It is understood that McKay & McDonald have sold their Missouri group of claims on Lehigh Creek and also are negotiating for the disposal of their Seattle group, on Cherry Creek. These properties have good showings of ore, and it is surprising that they have been idle so long when metal prices were high.

Ore may be stoped from the St. Paul group so that it may be shipped while the lead prices are high. There are a few cars of high-grade ore in sight there. This property is about 22 miles out of Libby.

H. E. Brink and a small group of associates are working their property on Prospect Creek this winter, and they report encouraging showings. It is also reported that the Alpine Portland operators are planning to install a power plant this spring, and then to push development until they get under an oreshoot that has been opened with an upper tunnel. The property is on Leigh Creek.

Joplin-Miami Milling Practice Needs Thorough Revision, Say Bureau Experts

Investigation Indicates That Prevailing 65 Per Cent Recovery Can Be Improved Greatly

The study of milling practice in the Missouri - Kansas - Oklahoma zinc-lead district, which has been in progress by the Bureau of Mines for some time, has revealed many weaknesses and the urgent need of improvement. For every 65 tons of mineral recovered about 35 tons are lost in the tailings. The "chattiness" of the ore and hardness of the flint gangue are the two principal factors preventing higher recoveries. The investigations thus far have been confined primarily to jigging and secondarily to tabling and other features of milling. The study of sludge-room conditions has also been carried on in conjunction with this investigation. Heretofore little effort to recover fine mineral has been made, although flotation has been tried in one or two plants.

The work has been centralized at two mills of the Commerce Mining & Royalty Co., namely the West Side and the Webber. A $10,000 slime plant was built at the West Side, and the classifying system for the sand tables has been greatly improved. A chat jig, which will satisfactorily handle from six to eight tons per hour of coarse, sized material, was also built at the West Side mill. The Webber sludge mill is now being dismantled with the intention of duplicating the West Side equipment and adding further refinements. The Vinegar Hill Zinc Co. is remodeling its Barr sludge mill in accordance with the plans at the West Side and the Webber.

It is believed that a thorough revision of the entire milling system is necessary. Information has been gathered on certain features of the mills and more data will be obtained. The various steps in the proposed revision are evident to the investigators; the coming year will be spent in working out details of some of these steps and in offering to the operators the advantages of the proposed improvements.

Many operators have given co-operation and extended numerous courtesies to the Bureau engineers engaged on this investigation. The Missouri School of Mines and Metallurgy, at Rolla, Mo., and the Miami School of Mines, at Miami, Okla., have also in many ways given their cordial co-operation to the work. All data and records of tests are available to any one interested.

Indian Government Drops Plan to Aid Burmese Tin Industry

By Cable from Reuters to "Engineering and Mining Journal-Press"

Rangoon, Feb. 18—It is announced that the government scheme to aid the tin industry which came into force in February, 1921, will be terminated on and from Feb. 15 in consequence of the rise in the price of tin.

New Cornelia Orders $2,000,000 Worth of Mill Machinery

Orders have been placed for about $2,000,000 worth of equipment that will be needed for the New Cornelia Copper Co.'s concentrator at Ajo, Ariz. These include contracts for twenty Marcy mills costing $350,000, to the Mine & Smelter Supply Co., and an order for a gyratory crusher and two large pumps has been tendered the Worthington Pump & Machinery Co. The price for the latter equipment was $70,000. This gyratory will be the largest ever erected in the Southwest, being a 54-in. machine, and will have a capacity of 5,000 tons per day. The battery of twenty Marcy mills are to handle the same tonnage. This equipment is to be delivered sometime in June.

High Price for Lead Stimulates Mining in Spain

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, Feb. 17—A message from Madrid states that the price of lead has increased to 642 pesetas per ton on wharf at Cartagena against 606.40 pesetas in January. If the rise proves permanent, veins which were unprofitable at previous prices will probably be worked.

Colorado Legislature Memorializes Congress to Aid Silver Mining

The following concurrent resolution has been passed by both houses of the Colorado Legislature and has been signed by the Governor:

"To the Senate and House of Representatives of the United States in Congress Assembled:

"Your memorialists, the Governor and Legislature of the State of Colorado, respectfully represent that:

"Whereas, the production of silver is an important industry of the United State, and affords employment directly to many thousands of persons and indirectly to thousands of others; and

"Whereas, on account of its association with other metals, especially lead and zinc, in ores, an inadequate price for silver increases the cost of production of lead and zinc, and thereby adds to the cost of materials essential to many construction activities; and

"Whereas, it is also desirable to maintain silver-mining operations in the United States, so as to meet the coinage requirements of various countries in which commerce and industry are in process of rehabilitation and cannot be fully re-established without additional supplies of metallic money; and

"Whereas, the prospective early completion of silver repurchases under the provisions of the Pittman Act is liable to disrupt the silver-mining industry of the United States and in part suspend silver production unless measures be taken to preserve the industry;

"Now, Therefore, Be and It Is Resolved, That the Governor and Legislature of the State of Colorado, respectfully petition the Congress of the United States to give sympathetic and early consideration to this phase of the silver-mining industry and enact such legislation as may be necessary in the premises."

Watchful Waiting Develops Ground for Coeur d'Alene Syndicate

Star Crosscut, Run by Others, Will Explore Ground Optioned by Syndicate Company

Many and varied are the ways in which orebodies have been discovered, but a situation is not recalled in which one company could literally rest on its oars while another company explored its ground by expensive development. But that is practically what the Coeur d'Alene Syndicate Mining Co. is doing. From this it must not be inferred that the syndicate has been in the least backward about spending its own money on development. For two years or more it has been engaged in developing a large group of claims lying between the Frisco and Star, owned by the Flynn group and Senator companies, upon which the syndicate has an option. The syndicate is controlled by well-known mining men in the West, including Seely W. Mudd, Phillip Wiseman, D. C. Jackling, and Horace V. Winchell. Under the direction of Rush J. White, mining engineer of Wallace, Idaho, the company has spent approximately $500,000 in development. It has found considerable ore, but the most likely ground is still unprospected; here is where the work of the other company comes in. The Sullivan Mining Co., owned half and half by the Hecla and Bunker Hill & Sullivan companies, is driving a crosscut from the 2,000 level of the Hecla mine to the Star vein, and in doing so it will pass through the Senator ground, where the syndicate management regards the chances are decidedly favorable for a big oreshoot. This crosscut will pass 1,700 ft. below the syndicate workings and 4,300 ft. from the surface. In this situation the syndicate has decided to await developments, and therefore has suspended all operations except diamond drilling, and this will also be discontinued upon completion of the work in hand. The Star crosscut is now about 1,000 ft. from the Senator side line, and is estimated to be about 2,000 ft. from the Senator vein; also about 3,000 ft. from the Star vein, its objective.

Work on Granby Concentrator Will Commence Soon

H. S. Munroe, general manager for Granby Consolidated M. S. & P. Co., stated that work on a 1,200-ton concentrator would be started at Anyox as soon as weather conditions permitted. This plant is to be erected to treat a large reserve of low-grade, siliceous ore, which cannot be treated profitably by direct smelting.

On Feb. 8, at a meeting held at New York, the shareholders ratified the decision of their directors to increase the number of shares in the Granby company from 250,000 to 500,000, and to purchase Canada Copper Corporation mine and plant, free from liabilities and with $800,000 in the treasury, for 155,000 shares of Granby common stock.

Tests Show Economy in Using Large-Size Dynamite

Sticks Should Be at Least 1¼ In. in Diameter for Best Results, Say Explosives Makers

The Institute of Makers of Explosives, in co-operation with engineers from the Bureau of Mines, in recent tests has demonstrated conclusively that both economy and safety in the use of explosives are lost by the use of dynamite in cartridges of ¾ or 1 in. diameter, and therefore, that every effort should be made to use drill holes of such a diameter as will accommodate cartridges of not less than 1¼ in. diameter. This applies particularly to gelatin dynamite.

It is generally agreed that "gelatin" dynamites rapidly become insensitive to detonation and explosion by influence on aging, whereas both "straight" and "ammonia" dynamites are little affected. Accordingly, in a practical consideration of the diameter of cartridges of an explosive to use for greatest efficiency, (1) the effect of aging on that diameter of cartridge must be considered at the same time as (2) the effect of the diameter of cartridge on the physical characteristics of the explosive. In addition, from a safety standpoint, the effect of both of the above must be considered in their bearing on misfires, incomplete detonations, and the quantity and nature of poisonous gases.

The tests carried out have shown:

1. That both the rate of detonation and sensitiveness to explosion by influence increase with the increase in diameter of cartridge.

2. That gelatin dynamites rapidly decrease in sensitiveness to detonation and explosion by influence on aging, though the ammonia dynamite was little affected.

3. That the insensitiveness of gelatin dynamites to detonation and explosion by influence on aging proceeds more rapidly the smaller the diameter of cartridge.

4. That the insensitiveness to detonation and explosion by influence proceeds more rapidly with 60 per cent strength L. F. gelatin dynamite than with 40 per cent strength L. F. gelatin dynamite.

As regards safety, the effect of cartridge diameter is important, as the more rapid decrease in sensitiveness to detonation of the smaller diameter is likely to cause more misfires, and the decrease in sensitiveness to explosion by influence is likely to cause more partial failures from foreign material in the borehole. Further, insensitive gelatin dynamite sometimes burns in the borehole instead of detonating, and on burning, gives off large quantities of oxides of nitrogen which are poisonous, even in small percentages. Also, in the smaller diameters of cartridge the proportion of paper wrapper to explosive ingredient is greater, and as most explosives on detonation give varying quantities of noxious gases, the smaller diameters of cartridge will give the greater quantities of poisonous gases because of this increased ratio of paper wrapper.

Aluminum Company Ready to Ship Bauxite from South America

The Demerara Bauxite Co., Ltd., a subsidiary of the Aluminum Company of America, the only company mining bauxite in British Guiana, is ready to resume exportation. The company shut down early in 1921 and did not export any ore in 1922, but mining was resumed late in the year, and it is expected shipments will be made soon.

The situation as regards the granting of Crown lands for the mining of bauxite is apparently the same as when, during the war, all Crown lands were withdrawn from entry for this purpose. It is, however, reported that a syndicate headed by the British Aluminum Co., Ltd., is negotiating with the Colonial Office in London for the remaining unoccupied Crown lands of the colony known to contain ore.

Swedish Mines Would Exchange Iron for Upper Silesian Coal

By Cable from Reuters to "Engineering and Mining Journal-Press"

Stockholm, Feb. 12—The Polish Legation at Stockholm has transmitted an offer of Swedish mines proposing an exchange of iron ore for Upper Silesian coal.

News from Washington

By PAUL WOOTON
Special Correspondent

War Minerals Claimants Impose on Government

Manganese Corporation Plays Both Ends, Says Commissioner—Gets Only Third of Amount of Additional Claims—Other Awards

AN ADDITIONAL award of $12,011.26 for the Southern Manganese Mining Corporation, of Birmingham, Ala., has been recommended by the War Minerals Relief Commissioner. The company, as a result of the findings of the former commission, and of the Secretary of the Interior, already has received $62,898.35 to cover war-time losses.

The Southern Manganese Mining Corporation was organized to work with the Southern Manganese Corporation. This latter company operated electric furnaces for the production of ferromanganese, while the Mining Corporation undertook to prospect for manganese and mine it where the deposits were of sufficient richness. It was contended by these companies that the electric-furnace process would permit of the use of ore of lower manganese and higher silica content than could be utilized in blast furnaces.

The Mining Corporation undertook widespread operations. Geologists, engineers, and prospectors were sent into several states to search for and examine deposits. More than seventy locations were accepted. The former commission eliminated a number of the prospects as not having been of commercial importance. The corporation asked the commission of this administration, however, that the work upon practically all of the properties prospected be considered as a single operation, thereby making the whole enterprise one of commercial importance under the act, even though commercial importance could not be established when some of the properties were considered separately. This proposal, however, does not meet with the approval of Ira E. Robinson, the War Minerals Relief Commissioner, who finds that "to hold prospecting and searching for ore over half a dozen states, where finds were few and failures many, was a single operation, the entire expense of which is reimbursable under the act, is impossible."

At another point in his opinion Commissioner Robinson says: "Claimant appears to be in an untenable position when he asks that in the payment of his expenditures the provisions of the act as now interpreted should apply, but that because of the scope of his operations and the peculiar method of reducing the ore, a different application of the term 'commercial importance' should be given. This would seem to be playing both ends, with the government in the middle, carrying all of the load. If the claimant found some of these properties to be of no importance to their project, as is admitted, they must be held to have been of no importance in the adjustment of the claim. In effect, the claimant asks that his prospecting operations be considered under one standard and the payment of his losses under another. It is not possible to apply different standards in the adjustment of claims.

"It is due to this claimant to say that he was importuned by a government agency to attempt production on a large scale. In response thereto he put into the market for war purposes 28,000 tons of manganese. In order to get results speedily, he sent out at great expense a flying squadron to search for deposits, and was commendably active in setting a vast organization at work to meet government needs.

"As to the geologists, Harkins, Nelson, and Dale, their work, while partly prospecting, was largely connected with ore treatment and the proper manner of disposing of the product of proven mines. It appears to be equitable to set off one-third as the amount connected with prospecting, which leaves $4,052.12 for which he is to be compensated."

The detailed allowances which con-

stitute the $12,011.26 additional award are as follows: Mills property, $1,150.96; Laramore property, $2,145.11; Neal property, $1,624.57; Gates property, $440.13; Fox property, $502.38; Grayson property, $223.64; salaries of geologists, $4,052.12; credit on salvage of equipment, $1,872.35.

Subject to the approval of the Secretary of the Interior, Commissioner Robinson has made the following recommendations of awards: J. S. Swann, Knoxville, $792; J. H. Hildreth, Callahan, Calif., $560; Walker and Arnold, Santa Margarita, Calif., $3,908.52; Bill-Jim Minerals Co., Holdenville, Okla., $300; L. C. Carpenter, Fresno, Calif., $408; M. E. De Bunce, Ephriam, Utah, $475; H. E. Graves, Bristol, Va., $1,290.38; Green River Mining Co., Denver, $3,615.15; Rare Metals Ore Co., Denver, $26,328.72; H. W. McDowell, Parker, Ariz., $2,160.75; M. J. Daens, Varney, Mont., $275.50. Disallowances were recommended as follows: James Carr, Philipsburg, Mont., not within the act; Halsell and Stafford, Oklahoma City, not within the act; Albert Parent, Duluth, net loss not established; H. H. Morrell, Crescent City, Calif., net loss not established; N. A. Adler, Batesville, Ark., not within the act; Williamson and Mullins, Jamestown, Calif., commercial importance not established.

No European Junket for Gold-Silver Inquirers

Hearings to be conducted by the Joint Commission on Gold and Silver Inquiry are to be confined to continental United States. This limitation was placed in the bill by the Senate committee on audit and control, so that the expenses of the commission would not be great. This amendment was accepted by Senator Nicholson, Senator Oddie, and the other members of the Committee on Mines and Mining.

There had been some thought that the commission should visit several of the European countries with the idea of gaining first-hand impressions as to the policies of those countries which affect gold and silver. There was no objection, however, to the limitation proposed by the Senate Committee on Audit and Control, as some of the members of the Committee on Mines and Mining believe that the information can be gathered better by specialists than by the commission itself.

The Committee on Mines and Mining of the House of Representatives has approved the legislation in the exact form of the Senate measure, which has been reported to the House with the recommendation that it be approved.

39,000,000 Oz. More!

Purchases of silver by the Bureau of the Mint during the week ended Feb. 17 amounted to 2,106,000 oz. This brings the total purchases under the Pittman Act to 158,126,912 oz. This leaves approximately 39,000,000 still to be purchased. October 1 seems to be a good guess as the latest date.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Sir Abe Bailey Unloads Cam & Motor Shares, and Another Boom Is Dead

BY W. A. DOMAN

London, Feb. 9—The excitement in Cam & Motor (Rhodesia) to which I referred recently has died down, and the shares have a declining tendency. The reason assigned is that Sir Abe Bailey, who had an option over 120,000 shares at par, is selling and reinvesting the money in Randfontein (West Rand). Development reports of the Cam & Motor covering four months—October to January—have just been published, and they do not seem quite to bear out the optimistic statements made when the shares were booming. A plan is issued with the quarterly report, and even then it is not easy to follow the work done. There is, however, a large patch to the south of the main shaft, between the 8th and 12th levels, containing what appears to be a continuous run of high-grade ore.

Being in want of funds, the Colombian Mining Co. is endeavouring to raise them by means of an issue of £100,000 of 8 per cent notes, current for three years. About 70 per cent has been underwritten. The security is the Echendia Mining Co. and the assets of the Colombian Mining Co., apart from what is covered by a mortgage of £10,700. The notes also carry an option over 100,000 shares at 5s. a share, the shares being provided by Shirley H. Jenks, the chairman.

A company called the Tominil-Espanola (Mexico) is said by its directors to be working the "Lost Mine of Zapotilla." They apparently base their views upon a statement cabled by Mine-Manager Cosset announcing that in the 60th level one sample of ore assays 4 oz. of gold to the ton. He thinks that by some further development in another part of the mine he can supply a mill treating 40 tons of ore daily. The capital of the company is £250,000 in 10s. shares, and he suggests that the directors should not issue any more shares under £5 per share. The market is well in hand and the price has been lifted from 5s. to 10s, as jobbers were caught short.

Hopes as to the result of the adoption of the new drill-sharpening process by the mines of the Rand have created a feeling akin to optimism, and already estimates are being made of savings to be effected. Even East Rand Proprietary, which was almost regarded as down and out, is being recommended as a property likely to derive considerable benefit. Nourse Mines is another company coming to the front. West Springs is reported to be opening up in a satisfactory manner, the northeast haulage being specially mentioned. This company is under the control of the Anglo-American Corporation, and as Sir Ernest Oppenheimer and J. S. Wetzlar have proceeded to the Cape, it is expected that the reduction plant will be decided upon. It is said that as times are not propitious the Anglo-American Corporation will advance the money.

Although no particulars have been published here, it is reported that the Transvaal Silver & Base Metal mines, controlled by the General Mining & Finance Corporation, are developing remarkably well, and in consequence a demand has sprung up for General Mining shares. For years the company has suffered from depreciation on its investments exceeding £1,000,000, but a large proportion of this has been wiped out by the purchase of ex-enemy shares.

Johannesburg Letter

"Price" of Gold Continues to Decline—Lion Hunting Near Messina Still Good

BY JOHN WATSON

The monthly gold output for December was declared by the Chamber of Mines on Jan. 10 as 790,712 fine ounces, having a value of £3,479,133, the realized price being £4 8s., or 3s. lower per fine ounce as compared with November. The increase over the previous month is 26,236 oz.; but only £767 in value, owing to the fall in the price. The month's operations have been, on the whole, normal. Of the individual mines, twenty-six show decreases and only sixteen show gains. From Modder B and Springs Mines came a special quantity of amalgam, equal to 36,930 oz., owing to a change in working their battery tables. Modder East shows an increase of 1,600 oz. and the City Deep an increase of 1,513 oz. Among the most notable decreases, Government areas is down 4,000 oz., Crown Mines 1,775, Van Ryn Deep 1,747, Simmer & Jack 1,696, Consolidated Main Reef 1,519, Ferreira Deep 1,210 and Randfontein Central 1,025. The native labor returns show an increase of 3,661 natives working on the gold mines and an increase of sixteen on the diamond mines, the totals for December being 176,834 and 1,253, respectively.

Colonel Grenfell, a director of the Messina Development Co., Ltd., (who is out on a visit to the Northern Transvaal), recently shot another lion on his ranch near Messina. This makes a total of nineteen lions shot on the ranch within the last two years.

The inspector of white labor reports, in the Johannesburg area, the applications for employment numbered 1,086, a decrease of 480 compared with November. Employment was found for 138, including 59 sent to relief works. It is reported that about 450 members of the Amalgamated Engineers' Union are out of work. The building trades are brisk. During November, the Johannesburg Municipality approved of 353 plans of private buildings.

Montreal Letter

"Too Much Silver" in London—Newfoundland Placers Attract Cash—Power Troubles

By Alexander Gray

Canadian silver producers are amused at the reports from London that there is too much silver in circulation. The banks are said to be at their wits' end as to what to do with it. Their vaults are full of it, "and it has been whispered that the dungeons of the Tower of London have been requisitioned to store the surplus metal." In all seriousness, Cobalt and British Columbia mine owners regard this as a sad fate for much of the subsidiary coinage in which the Lloyd George government reduced the silver content. Of course the dungeons have their more appropriate uses, but it is felt the spurious money should be there, too.

A winze at the Teck-Hughes has reached a depth of 1,000 ft. It is the intention to go to 1,100 ft. The property is being comprehensively dealth with, the January production being $89,300. The 400-level workings are being extended into the recently acquired Orr property. The same course will be followed on the 500, 600, and 730 levels. Owing to the improvement in widths and values in the lower levels of the Teck-Hughes, the management will concentrate upon that area when a depth of 1,100 ft. is attained.

Regardless of admonitions and the manifest unwisdom of taking it for granted that Labrador has placers by the hundreds of square miles, it is common report that one company has from $800,000 to $1,000,000 on hand, provided by eager speculators who want to be in at the start. It was hoped that Newfoundland Government would intervene with a reminder that proof of the extent of the placers is lacking, and that leading authorities doubt the occurrence as represented. Reams of documents entitling contributors of $200 each to leases, and the persistent solicitation of further subscriptions, have aroused the sincere well-wishers of all such ventures, who fear the after effects will be more than disappointing. The movement has assumed international proportions—and yet there is no proof that the placers are extensive. Even the Newfoundland Government could not verify the representations of certain of the promoters, and will not be able to for some months. Meanwhile the shekels have poured in.

ONTARIO

Hollinger Power Project Still Doubtful

Following the official statement made a short time ago by the Hollinger that the company had secured the rights to power development at Island Falls, on the Abitibi River, it is now learned that no lease has been given, and that the Hollinger announcement was, to say the least, premature. It is probable that statements such as this are made with a view of influencing public opinion to back the company in its fight for power rights, although in view of impending litigation it is doubtful if construction could be started even if the lease were obtained. The Northern Canada Power Co. is suing the Hollinger for the enforcement of a power contract covering full requirements of the mine. The situation is further complicated by the fact that on account of low water the power company has found it necessary to put another cut into effect, and all the operating mines will have to curtail either production or development work. The new Sandy Falls unit has not yet started and probably will not be in operation before March, so that power will be short until the spring break-up. The Hollinger was using about 9,000 hp. last spring and is now receiving only between 4,000 and 5,000. It is urged by many that the annual repetition of power troubles is a serious deterrent to the financing of new enterprises.

Best Report in History of Kirkland Lake District

The annual report of the Wright-Hargreaves company in Kirkland Lake for the year 1922 is the best report issued by a mining company since milling first started in the district. During the year 66,181 tons of ore was milled, from which was recovered bullion to the value of $762,753, or an average of $11.52 a ton. Costs of operation were $418,122, or $6.31 a ton, and the net profit was $344,630. The balance sheet shows current assets of $274,125 and current liabilities, including a provision of $68,750 for the January dividend, amount to $108,414. During the year dividends to the amount of $412,000 were paid and the surplus was reduced to $6,424. The shaft was sunk to 865 ft. and will be continued to 1,000 ft. and it is anticipated that during the coming summer the mill will be enlarged. The report gives no estimate of ore reserves, but states that 33,000 tons are broken in the mine.

MEXICO

Sombrerete Properties Active

Charles E. Schnider, operating in the Chalchihuites district, is developing the Purisima y Anexas property, comprising fifteen claims. He is encountering some high-grade silver-lead ore in both the shaft and tunnel, where he has a force of men at work. No ore is shipped, but a large amount is being blocked out.

The old Coburo mine continues to operate, shipping about three cars of ore each week to the smelter of the American Smeltering & Refining Co. at Asarco. These ores are loaded at the Canutillo station on the Cañitas and Durango branch. Gustavo Bindel is in charge. Some of the ore is high grade, assaying 100 oz. of silver to the ton, with good lead values.

Forbes Rickard has purchased the Guarda property, in the Noria district, and is going to prove it up with diamond drills. Some of the old buildings are being reconstructed and other improvements made.

BRITISH COLUMBIA

Mobile Property Financed

The Portland Canal district seems to hold the spotlight so far as attracting capital to British Columbia is concerned. Eastern Canadian capitalists, of whom Clarence McQuaig, of Montreal, is said to be the leader, have taken an interest in Mobile Mines, Ltd., and ample capital now is assured for the thorough exploration of the property. It is situated at a considerable elevation above Glacier Creek, a tributary of Bear River, and an outcrop of high-grade silver-lead ore has been traced for a considerable distance on the surface.

Woodbine Group Will Be Developed

H. B. McGuire has returned to Stewart from New York, where he succeeded in interesting capitalists in the Vancouver and Woodbine groups of sixteen claims, situated on Cascade Creek, northwest of the Indian group. Three lodes have been opened on the surface. One is a large low-grade body of ore, 150 ft. wide. Whether or not the grade is high enough for mill feed in this district remains to be demonstrated. About 700 ft. north of this lode, and parallel to it, a strong lode has been opened at several points, some of which show high-grade ore, the general character of which is said to be similar to Premier ore. Little work has been done on the third lode, which is still farther north. Ample capital for exploration is said to be available.

Treasure Mountain Property Shows High-Grade Silver-Lead Ore

American interests have a crew of men working this winter on the Treasure Mountain property near Tulameen, under the management of John A. Carlson. Work has proved some fine high-grade silver-lead ore. In the East drift 3 ft. of high-grade concentrating ore with steel galena; in the West drift over 1 ft. of clean galena with 3 ft. of concentrating ore. This ore will run better than $100 per ton. A sample of ore from the Whynot claim assayed 191 oz. silver and 84 per cent lead. In the Eureka claim the vein is 19 ft. between walls. A tunnel is being driven on top of this vein. On the Queen Bess open cuts and surface work show a vein 8 ft. between walls, 7 ft. of high-grade concentrating ore and 1 ft. of calcite and quartz. Solid seams of ore 2½ in. wide have been traced in this vein for 2,000 ft. Lack of transportation has retarded the work, but the Provincial Minister of Mines, William Sloan, has assured the people who are developing the district that a road will be built this spring.

Trail Production Figures

The following is the metal output of the Consolidated Mining & Smelting Company's smelter, at Trail, for 1922: Gold, 18,777 oz.; silver, 2,078,308 oz.; copper, 1,243,477 lb.; lead, 84,378,535 lb.; and zinc, 56,289,083 lb. The total value of the output is estimated at $9,092,257; 411,612 tons of ore was treated.

CALIFORNIA

San Francisco Correspondence

Reports of Resumption Premature—Island Mountain Ships

Rumors are current that the Mammoth mine, owned by the U. S. Smelting, will resume, but the report is premature. Apparently there is no present intention of resuming. The Shasta Zinc & Copper Co. is stated to be also about to resume, but the San Francisco office of that company states that though it is probable that the company will start operation again within a few months, no announcement to this effect has yet been made. Local papers credit the Mountain Copper Co., Ltd., with a monthly production of iron ore amounting to 1,500 tons. It is stated that this ore is being shipped to Tacoma. It is a fact that this company has iron ore available at its mine and a large quantity of tailings rich in iron at its Martinez plant, but it is not making shipments to Tacoma. In fact, it would like to secure a customer for its ore and tailings. On the other hand, the Island Mountain mine, at Island Mountain, Trinity County, is shipping 1,000 tons per month of low-grade copper ore to the Tacoma smelter.

Present Engels Copper Management Sustained by Stockholders

The Engels Copper Co. is producing in excess of 1,000,000 lb. of copper per month and is showing a decided operating profit. Henry Engels, as a stockholder, presented a report criticizing the conduct of the company's affairs at the recent directors' meeting, but did not succeed in his objective, which has been to change the present management. E. E. Paxton is general manager and R. A. Kinzie is in direct charge of operations. The new adit under construction has reached a length of 6,000 ft. The present outlook of the company is excellent.

J. C. Benson Options Mother Lode Mines

Options have been taken on the Bund, Monarch, and Jack Rabbit, near Angels Camp, by John C. Benson. The Bund is a prospect that has been idle for a long period. The Monarch and Jack Rabbit are old-time gravel mines. Benson has also an option on the Demarest mine.

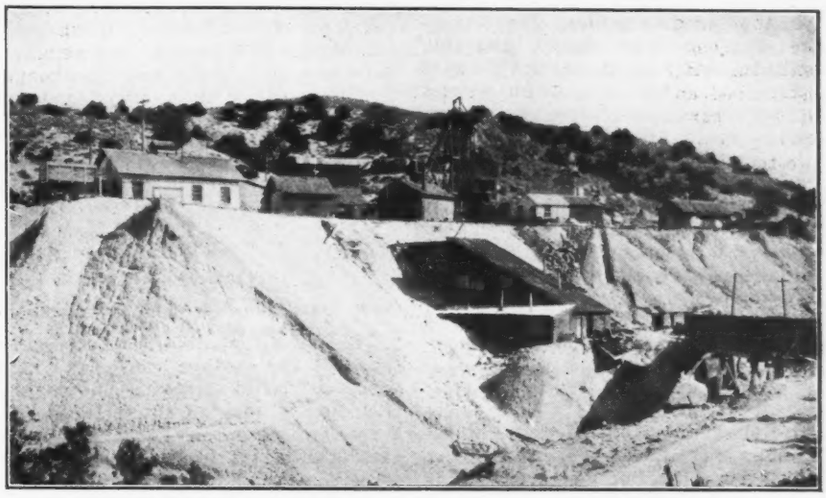
NEVADA

Tonopah Bullion Production

Tonopah continues its bullion production at the same rate as for the last several years. Tonopah-Belmont production is decreasing, Tonopah Extension increasing, and that of the other two large companies, the Tonopah Mining Co. and the West End, remains unchanged. Bullion shipments for the latter half of January were as follows: Tonopah-Belmont, $96,250; Tonopah Extension, $103,000; West End, $76,600; Tonopah Mining Co., $50,000. Owing to heavy storms in the White Mountains, through which the electric power line to Tonopah and southern Nevada passes, power service was interrupted on Feb. 12, and one day's operation was lost.

Deep Mining Helps Tonopah

Deeper mining might well be used as a watchword for the Tonopah district. At the Victor shaft of the Tonopah Extension the 2,000 station is being cut. An intermediate level, known as 1,928 level, has been established from a winze from the 1,880 level at an elevation approximately halfway between the 1,880 and the 2,000 levels. The winze above mentioned has followed the hanging wall of the Murray Vein and has been in good ore for its entire length. The Buckeye shaft, which is included in ground under lease to the Belmont Co., has passed the 1,500 mark. It is planned to sink to the 1,600 before crosscutting unless water interferes. The Tonopah Mining Co. has resumed sinking in the Merger winze below the 1,400 level. The West End is resuming sinking on the West End vein, the deepest workings on this vein being at about the 800 level.



Old surface plant of the Simon Silver-Lead Co. at Mina, Nev.

Rochester Produced $55,121 in January

The Rochester Silver Corporation, operating at Rochester, reports January production as 5,222 tons of ore, with a gross value of $55,121. This compares favorably with production of previous months. Additional ore blocked out about equaled ore stoped during the month.

Simon Silver-Lead Installs Heavy Equipment at New Shaft

The Simon Silver-Lead Co., operating near Mina, is installing a new hoist to serve the new three-compartment shaft that has now been completed to the 550 level and a new compressor, much larger than that used heretofore. Numerous alterations designed to increase the capacity of the flotation plant and give more economical operation are also under way. The new headframe has been finished, and production is scheduled to start within two months. J. F. Thorne has been made manager, P. A. Simon remaining as president.

IDAHO

Repeal of Profits Tax Proposed

A bill has been introduced in the Idaho Legislature repealing the net profits tax law. The passage of the bill would result in placing mines in the same class with other property, making them subject to taxation on a basis of valuation. Under the present law mining companies of course pay taxes on all real property and improvements the same as other taxpayers, and in addition they pay on the net profits of the preceding year as determined by sworn operating statements filed in the office of the county assessor. The mining interests of the state hope to be able to defeat the bill, as its effect would be a serious blow to mining in Idaho.

Activity Near Clark's Fork

A vein of galena ore 25 ft. wide, of milling grade, is said to have been cut on the Broken Hill property, near Clark's Fork, in driving a crosscut tunnel for the main vein 350 ft. below the outcrop. The tunnel was estimated to be within 85 ft. of its objective when this ore was encountered.

WYOMING

Precious Metal Ore Being Shipped

The Electrolytic Copper Co. has opened several shoots of good ore in the old Rambler mine, situated 45 miles southwest of Laramie, Wyo. The ore contains copper, gold, silver, platinum, palladium, and nickel. Shipments have been made both to Utah and to New Jersey. One carload lot sent to a New Jersey refinery returned as follows: Gold, 0.27 oz.; silver, 2.5 oz.; platinum, 0.18 oz.; palladium, 0.53 oz.; copper, 8.99 per cent. In spite of a freight charge of $15 per ton of ore, a good profit is made. Deepest workings on the property reach 185 ft. The deposit is in a dike that can be traced for 30 or 40 miles across the crest of the Medicine Bow range in Albany County. Considerable prospecting is being done along the dike.

WASHINGTON

New Magnesite Product Will Be Made

A firm of Spokane business men, recently incorporated with a subscribed capital of $50,000, has purchased the factory of the Western Materials Co. at Mead, Wash., in which has been installed modern machinery for manufacturing 50 tons of magnesite product per eight-hour shift. This product will be used for outside building stucco and flooring purposes. Its decorative value has been proved in the last few years throughout the Northwest. The source of the raw material is a large magnesite deposit in Stevens County, Wash., near the Canadian border. The magnesite is removed by simple quarrying methods. After being quarried the rock is crushed and calcined, which reduces it to a pure powder free from most foreign matter; this product is shipped to the factory at Mead, where a second crushing and grinding is given to pulverize the ore to the finest of flour. It is then elevated to a bin and fed into a mixer, which fuses it with other material necessary to make the final product. Several colors are obtainable, and when used as plaster or stucco it is said to be crack proof, cool in summer, and warm in winter.

Republic Production Jumps

Ore production from the mines of the Republic district has been increasing for some months, but there was a sudden spurt in January. This is indicative of the marked activity in this gold camp. In December, 1922, 1,500 tons of ore was shipped, and in January, 1923, more than 3,000 tons was sent to the Trail smelter.

UTAH

Chief Consolidated Produced 3,768,390 Oz. of Silver in 1922

The Chief Consolidated company, at Eureka, in the Tintic district, Utah, produced more silver and lead ores in 1922 than in any former year. During the year there was shipped 113,790 tons of ore, which, after payment of smelting, transportation, and all operating charges, brought $524,325. The net per ton value of all ore exceeded that of 1921 by $2.60. During the year there were paid two quarterly dividends of 5c. a share, or $44,201 each, and two dividends of about 10c. a share, or $88,430 each. These, with the first quarterly dividend of $89,221 for 1923, bring the total by the company to $2,402,846. Silver production amounted to 3,768,390 oz., and the mine was probably the largest single producer of silver among the silver-lead mines of the United States. There was an increase in silver production for the year of about 36 per cent and an increase of about 58 per cent in lead. Ore channels below water level are persisting in value and extent. During the year large increases in territory were made. Ores from the Chief Consolidated mine carried 0.0414 oz. of gold, 35.05 oz. of silver, 14.02 per cent of lead, and 1.28 per cent of copper.

Utah Apex Plans Increased Mill Capacity

Arrangements are being made to increase the capacity of the Utah Apex mill, which is at present 200 tons daily, so that it will be possible to treat 400 tons. The mill is now making an excellent recovery, and a good ore shoot has been opened on the 1,800 level.

WISCONSIN

Florence Company Resumes

The Florence mine, at Florence, at the western end of the Menominee Range, has resumed operations after a shutdown of two years. All the available miners who were former employes have been given work, and it is thought that the most of those who found employment at other places will return, as many of them own their own homes in Florence. The Ernst mine, owned by the Florence Iron Co., will be started up again early next spring.

ARIZONA

New Dominion Resumes Development

The New Dominion Copper Co. is the first real copper prospect in the Globe district to start since the depression, and is making satisfactory progress with retimbering the shaft and getting the plant in condition to resume development. The condition of the shaft was such that it was necessary to do considerable retimbering, and about 130 ft. of this has been completed to date. This work is to be continued, repairing where needed, until the 800 level is reached, where sinking will be started. The shaft will be sunk to the 1,000 or 1,200 level. The Dominion also has an option on the Irene mine, which adjoins the property on the east and north. Leasors are now operating at the Irene mine, having obtained a contract before the acquisition of the option by the New Dominion company. A car of ore which they recently shipped to the El Paso smelter contained 22 oz. silver and 42 per cent lead. W. Porri, formerly chief geologist for the Old Dominion company, is superintendent of the New Dominion mine.

MICHIGAN

Oliver Company Starts 4,000-Ft. Shaft

The new Royal shaft of the Oliver Iron Mining Co. was started Feb. 14 near Ironwood. Preliminary sinking had been done to a depth of 15 or 20 ft. to permit building the steel and concrete collar, but the regular sinking of the shaft has just been started by a shaft crew of thirty miners working in three eight-hour shifts. The shaft will be one of the largest and best equipped on the range, and will be ultimately sunk to a depth of 4,000 ft.

Shaft Will Be Gunited

Guniting of the new No. 5 shaft of the Montreal mine was recently begun at the 12th level. The shaft is in hard greenstone, and so has not been lathed at all, and the steel sets are 7 ft. apart. The gunite, it is expected, will prevent decay or loosening of the blocking, besides preventing any rock from spalling off.

Experts Testify in "Wasteful Mining" Action

The case of George L. Woodworth and others against the Buffalo Iron Mining Co., brought in the Marquette Circuit Court, has been carried over until next term. It involves damages placed at $80,000 for alleged wasteful mining methods by the defendants, in the operation of the Homer mine, in the Iron River district of the Menominee Range. About sixty witnesses were present, these including Warren J. Mead, professor of geology, University of Wisconsin; Steven Royce, assistant geologist, University of Wisconsin and now at Crystal Falls, Mich.; F. W. Van Slyke, mining engineer and geologist, Duluth and Virginia, Minn.; R. A. Archibald, geologist and mining engineer, Negaunee, Mich., and E. L. Laing, mining engineer, Iron River, Mich. The case will undoubtedly be taken up to the Supreme Court and the ruling will affect the rights of fee owners and lessees of several upper peninsula mines.

New Mechanical Shovel Being Tried

Scarcity of miners impels all Lake Superior region mining companies to introduce labor-saving appliances wherever possible. The most recent innovation in the way of an underground shovel is being tried at several of the mines in this district. It is the Mayne, described in the *Engineering and Mining Journal-Press* of Feb. 10. High efficiency is reported.

JOPLIN-MIAMI DISTRICT

St. Louis S. & R. Co. Builds Two Mills

Two mills are being built by the St. Louis Smelting & Refining Co., on leases of the Imbreau land, south of Hockerville, Okla. One will be known as the No. 4 mill and the other the No. 5. The first will be operating before the last of March, it is expected, and the other a few weeks later. Draining of the ground, which already has been developed somewhat, is proving more of a task than had been anticipated. Charles W. Schwarz, Miami, Okla., is manager.

Howe Company Will Mine Shallow Ore

The Howe Mining Co., Picher, Okla., is constructing a 300-ton hopper underground at its property. It is, at the same time, driving a drift upward to tap a run of shallower ore, which will be handled altogether through the underground hopper.

Beaumont Mill Capacity Increased

The Beaumont Mining Co., which some time ago took over the Brown-Head mine, near Treece, Kan., has completely rebuilt and enlarged the original concentrator until now it is capable of handling 400 tons per ten-hour shift. Power for all the operations at the mine is furnished by two 250-hp. gas engines.

THE MARKET REPORT

Daily Prices of Metals

Feb.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
15	15.125	40.125	41.375	8.00	8.05@8.15	7.00@7.15
16	15.25@15.375	41.00	42.375	8.00	8.00@8.15	7.00@7.20
17	15.50@15.625	41.25	42.50	8.00@8.15	8.00@8.15	7.10@7.25
19	15.625@15.75	41.25	42.875	8.00	8.00@8.15	7.20@7.30
20	15.75	41.00	42.625	8.00@8.20	8.025@8.15	7.20@7.30
21	15.75@15.875	41.50	43.125	8.00	8.025@8.15	7.20@7.30

*These prices correspond to the following quotations for copper delivered: Feb. 15th, 15.375c.; 16th, 15.50@15.625c.; 17th, 15.75@15.875c.; 19th, 15.875@16c.; 20th, 16c.; 21st, 16@16.125c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
15	66⅝	67⅜	73	187½	189¾	28¼	28	35⅛	35
16	67¾	68½	74½	191	193	28¼	28	35⅝	35⅝
19	68⅝	69⅝	75½	193	194⅞	28½	28½	35¾	35⅞
20	69	69¾	76	191½	193½	28⅜	28⅛	36	36⅛
21	68⅜	69⅝	75½	193¼	195	28½	28¼	35⅞	35⅝

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver			Feb.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
15	4.68⅜	99⅛	63⅞	30⅝	19	4.69¼	99⅝	64⅛	30¾
16	4.68⅝	99⅝	63⅞	30⅝	20	4.70¾	99⅝	64⅛	30 11/16
17	4.68¾	99⅝	63⅞	30 11/16	21	4.71¼	99⅝	64⅜	30¾

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, Feb. 21, 1923

The non-ferrous metal markets have passed through one of the most active weeks in several years. Consumers of copper, lead, and zinc have bought heavily of each of the metals, and the copper market, in a spectacular daily advance, has reached a level which few thought possible one or two months ago. Even tin buying has improved, and prices rose during the week. The price increases are a reflection of improved business conditions in the United States and a lessened tension over Europe.

Copper

For many copper producers the last seven days have been the busiest, so far as sales go, for a long time. Heavy purchases of copper were made, and manufacturers have been kept active marking up the prices of finished products to keep pace with the rise in price of the raw materials. The copper market advanced in price about an eighth of a cent per day and scored an advance of over one cent during the week. Comparatively a few days ago it was possible to buy copper for 15c. per lb.; now it can be obtained only with difficulty at 16c. delivered. In fact, some copper has been sold for 16.125c. and 16.25c. per lb., but it is still available at 16c. The rapid rise in the price of copper, as usual in buying waves, caused some consumers to anticipate requirements and place orders that ordinarily would wait. This action naturally intensified the demand for the metal and had its effect on prices. It is noticeable that some large consumers have stayed out of the market, as their current and future requirements were filled last year when copper was selling much lower. Producers are not looking for any reaction in price, as the demand is founded on a substantial demand from consumers. One producer finds himself so well sold out of metal that should the present demand continue he will have to withdraw from the market. The prevailing price of copper will have a stimulus on production, but any increase will be made slowly, as labor conditions are far from satisfactory. Although the rise in price is a result of splendid domestic business, export trade has been fair. Germany has again been in the market, and the tonnage sold abroad has kept at least one producer from active participation here.

Lead

The official contract price of the American Smelting & Refining Co. continues at 8c. per lb. New York.

The lead market has not shown much if any change. The volume of business done has been highly satisfactory, with the heaviest tonnage sold at the 8c. level. However, sales of good sized tonnages were made at higher prices in the New York market, realizing 8.15 to 8.20c. to the seller. Since Thursday there has been a slight falling off in business and inquiries, and the tight situation with regard to shipments of prompt metal has become easier; but a strong demand for lead still exists. The St. Louis market remains above New York, but this discrepancy is bound to disappear. either through an increase in the New York price or a decline in St. Louis. Imported lead is the controlling factor. Sales of lead in Chicago during the week were larger than usual, and the market there is about on a parity with St. Louis.

Zinc

Galvanizers showed a greater interest in zinc. Large sales were made by one of the leading interests. Export business has also been good. Under the stimulus of these forces prices rose. An important steel manufacturer, who has been out of the market, was a purchaser during the week. Today it is possible to obtain prompt shipment for 7.30c., while forward metal is lower, depending

upon the month of delivery. It is noteworthy that the premium on prompt metal is getting smaller. High-grade metal continues to be sold for 7.75@8.25c. per lb., with usual freight allowances.

Tin

Sales of tin were unusually large, but rather erratic, a heavy tonnage being sold on one day and the next witnessing only a slight activity.

Arrivals of tin, in long tons: Feb. 13th, Straits, 350; China, 150; 14th, Straits, 5; 19th, China, 75; Straits, 25; Rotterdam, 20.

Gold

Gold in London: Feb. 15th, 88s.; 16th, 87s. 11d.; 19th, 87s. 9d.; 20th, 87s. 6d.; 21st, 87s. 5d.

Stock of money in the United States, Feb. 1: Gold coin and bullion, $3,937,561,887; standard silver dollars, $454,554,404; subsidiary silver, $269,102,927; United States notes, $346,681,016; Federal Reserve notes, $2,632,726,815; Federal Reserve Bank notes, $38,348,000; National Bank notes, $763,750,961; total, $8,442,726,010. Money in circulation per capita, $40.74.

Foreign Exchange

Movements in exchange have varied. Sterling, the leader, has registered new highs. On Tuesday, Feb. 20, francs were 6.09c.; lire, 4.83c. and marks, 0.0042c.; Canadian exchange 1½ per cent discount.

Silver

The London price has advanced slightly during the last week, and New York has shown more than an equivalent rise, on account of the sharp improvement in sterling exchange. There has been a fair demand for New York silver, and China bought moderately, both in London and for San Francisco delivery.

Mexican Dollars — Feb. 15th, 49¾; 16th, 49¾; 17th, 49¾; 19th, 49¾; 20th, 48⅞; 21st, 49⅛.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—General market for 99 per cent grade, 24c. per lb.; 98 per cent, 23@23.5c. London quotations, £90@£100.

Antimony — Chinese and Japanese brands, 7⅛c. W. C. C. 7⅜c. Cookson's "C" grade, spot, 8¼@8⅜c.

Bismuth—$2.55 per lb. London quotes 10s.

Cadmium—$1.15 per lb. London quotes 4s. 6d. @ 5s. 6d.

Iridium—$260@$275 per oz.

Nickel—25@30c. per lb. for 99 per cent virgin metal.

Monel Metal—Shot and blocks, 32c. per lb.; ingots, 38c.; f.o.b. W. Va.

Osmium—$80@$85 per oz., Los Angeles. Supply scarce

Palladium—$79 per oz.

Platinum—$110-$114 per oz.

Quicksilver—$70 per 75-lb. flask. San Francisco wires $68.65. London £10 10s.

Selenium—$2 per lb.

The prices of **Cobalt, Molybdenum, Radium, Rhodium, Tellurium** and **Thallium** are unchanged from prices given Feb. 3.

Metallic Ores

Chrome Ore—Indian chrome ore, $19 per ton, c.i.f. Atlantic ports. Rhodesian and New Caledonian, $24 per ton. Market quiet.

Manganese Ore—33c. per long ton unit, seaport, plus duty. Chemical ore, $75@$80 per gross ton.

Molybdenum Ore—65@70c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates.

Tungsten Ore — Wolframite, $8; scheelite, $8.50@$9 per unit of WO_3, f.o.b. New York.

Iron Ore, Magnetite, Tantalum, Titanium, Uranium, Vanadium, and **Zircon Ore** are unchanged from the quotations published Feb. 3.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 17—Zinc blende, per ton, high, $44.95; basis 60 per cent zinc, premium, $43; Prime Western, $42; fines and slimes, $41@$38; average settling price of blende, $42.13. Calamine, basis 40 per cent zinc, $26@$28; average, $26.51 per ton.

Lead, high, $110.80; basis 80 per cent lead, $110; average settling price, all lead, $103.97 per ton.

Shipments for the week: Blende, 12,910; calamine, 150; lead, 1,667 tons. Value, all ores the week, $715,000.

Purchases for the week amounted to 15,920 tons of blende. For the three weeks this month the total was 46,710 tons, 9,000 tons more than the shipment of the same period. The Falcon Zinc company has a buyer in the field. This is the company organized by Lanyon interests. The Ozark Oxide company is also buying some ore. The Weir Smelting company has resumed regular buying and shipments.

Platteville, Wis., Feb. 17—Blende, basis 60 per cent zinc, $45.50 per ton. Lead, basis 80 per cent lead, $111 per ton. Shipments for the week: Blende, 706 tons; lead, none. Shipments for the year: Blende, 5,041; lead, 80 tons. Shipments for the week to separating plants: 541 tons blende.

Non-Metallic Minerals

Feldspar—No. 1 pottery grade, $6@$7.50 per long ton; No. 2, $5@$5.50; f.o.b. North Carolina points. No. 1, $7.50; No. 2, $6.50; ground, 60 to 80 mesh, $18@$20 per short ton; 120 to 150 mesh, $20@$24; 200 mesh, $25@$30, f.o.b. Connecticut points. No. 1, Canadian, $25 per net ton, f.o.b. Ohio mills.

First quality ground, $19 in New Hampshire, $18 in Maine; second quality, $16 in New Hampshire. In Colorado, No. 1 crude, $5; No. 2, $4.50 per short ton.

Asbestos, Bauxite, Barytes, Chalk, China Clay, Diatomaceous Earth, Emery, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and **Tripoli** are unchanged from the Feb. 3 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13.50@14.50c. per lb.

Nitrate of Soda—$2.60 per 100 lb.

Potassium Sulphate, Copper Sulphate and **Sodium Sulphate** are unchanged from quotations of Feb. 3.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $102.50@$107.50 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $37, f.o.b. furnace; 16@19 per cent, $36.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published Feb. 3.

Metal Products

Copper Sheets—Base price, 23¾c. per lb. **Wire**, 18@18½c.

Nickel Silver—29¾c. per lb., for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 21⅜c. per lb.; rods, 18⅜c. per lb.

Zinc Sheets and **Lead Sheets** are unchanged from the prices published Feb. 3.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the Feb. 3 prices.

The Iron Trade

Pittsburgh, Feb. 20, 1923

The steel market has grown quite excited, many buyers putting out additional inquiries when they were supposed to be already entirely covered.

Demand for definite construction work has been increasing steadily and is now heavy. Fabricated steel lettings in January were 75 per cent of capacity, the highest since May, 1922.

Steel prices continue to stiffen. Billets and sheet bars can hardly be bought at less than $40, against $36.50 at the beginning of the year, and bars, shapes and plates are at 2.20c. minimum, $4 a net ton advance since Jan. 1.

Pig Iron—The market continues dull, but prices are firmer, at $28 for bessemer and $26 for basic, with foundry unchanged at $27 to $28, all at Valley furnaces, with $1.77 freight to Pittsburgh. For two months consumers have been expecting lower prices in pig iron, but the steel works recently withdrew as sellers, and two, Republic Iron & Steel Co. and Youngstown Sheet & Tube Co., have just bought Connellsville coke to July 1 to operate reserve furnaces, not covered by their own by-product coke capacity, thus diminishing the prospect of a coke decline which would help a decline in pig iron. The purchases were at about $6.75. Prompt coke has eased off in the week, to $6.75@$7.

Facts for the Stockholder

VII—Federal Mining & Smelting Co.

THE FEDERAL MINING & SMELTING CO. was incorporated in Delaware, June, 1903. It acquired the properties of the Empire State-Idaho Mining & Development Co., the Standard Mining Co., and the Mammoth Mines, in Idaho; also smelting property at Everett, Wash., which was subsequently disposed of. It controls, through stock ownership, the Black Hawk Mining & Development Co., Ltd., and the Wyoming Mining & Milling Co., Ltd., and owns 28,000 shares of the Bunker Hill & Sullivan Mining Co., 414,000 shares of the Government Gulch Development Co., 50 per cent of the capital stock of the Green Hill-Cleveland Mining Co., and other properties in Idaho and Montana.

Its chief operating properties are silver-lead mines in the Coeur d'Alene district, Idaho, the Morning mine being the most important. Ore reserves are about 1,400,000 tons. The property is well equipped with concentrating, hoisting, air-compressing, and power plants. The company recently paid $171,283 for a 55 per cent interest in the Lucky O. K. Mining Co., in Kansas, the first earnings of which are to be devoted to the repayment of the purchase price with 6 per cent interest, and after this repayment, profits are to be divided in proportion to stock ownership. The ore carries 1 to 5 per cent lead, and 3 to 15 per cent zinc. There is a well-equipped mine and a 300-ton flotation plant. Company also owns the Brewster mine, in the St. Louis district, Oklahoma, for which it paid $125,000, and on which it has expended about $100,000 for a flotation mill and other equipment.

Capital consists of 120,000 shares of 7 per cent cumulative preferred stock, par $100; and 60,000 shares of common stock, par $100. There is no funded debt.

Prior to 1914, the company was a heavy producer, and net income averaged around $1,000,000 per annum, but in later years production and earnings fell off, and in 1921 there was a deficit of about $360,000. Earnings for the last quarter of 1922 were $445,456, compared with $142,848 in the first quarter. Net for the year was $970,330, before depreciation and depletion.

The 7 per cent dividend was paid regularly on the preferred stock from 1903 to 1911, and subsequently as follows: 1912-13, 6 per cent; 1914, 5; 1915, 4; 1916, 4½; 1917 and 1918, 7; 1919, 3½; 1920, 6; 1921, 4; 1922, 4¾. June 15, 1922, the quarterly rate was increased from 1 to 1¼ per cent, and the present rate is 5 per cent per annum. No dividend is paid on the common stock, the last payment of 1½ per cent having been made Jan. 15, 1909.

At the close of 1921, current assets were $1,768,000, current liabilities $180,000, and net working capital $1,588,000. Assets applicable to preferred stock, after deducting accrued preferred dividends, amount to about $80 a share. Present financial position is excellent. Cash assets and Liberty notes exceed $1,500,000, with practically no current indebtedness. The accumulated preferred dividends amounted to 19¼ per cent on Dec. 15, 1922.

The entire production of Federal Mining & Smelting Co.'s silver-lead ore, slime, and concentrate is sold to the American Smelting & Refining Co., under a contract dated October, 1905, and terminating September, 1930. The company is allowed 90 per cent of the contents of its lead ore at 90 per cent of New York quotations when lead sells at less than 4.1c. When greater, the difference between this and the market price is divided. Silver is paid for at New York quotation for 95 per cent, gold at $20 an ounce for 95 per cent. Deductions include $8 a ton treatment, plus freight to smelter, and 50c. a ton for each 1 per cent of zinc in excess of 10 per cent. Federal cannot dispose of its stock in a company owning or leasing mining property without previous written consent of the A. S. & R. Co. Late in 1922, a contract was made with the U. S. Smelting, Refining & Mining Co. for the sale of the zinc product of the Morning and Success mines.

During 1922, ore production aggregated 588,900 tons, of which 305,960 tons was from the Morning mine, 109,695 from the Brewster, 66,483 from the Lucky O. K., 56,245 from the Farmington, 44,748 from the Independence, and 5,769 from leasers.

Price range of the shares during the last five years has been: Preferred, high, 62¾, September, 1922; low, 21 in 1921; Feb. 17, closing, 53¾. Common, high, 23¼ in 1919; low, 5 in 1920; Feb. 17, closing, 11¾. INVESTIGATOR.

Potential French Demand for Copper Is Large

SPECIAL CORRESPONDENCE

Paris, Feb. 3, 1923—The situation may be briefly characterized by saying that the present events in the Ruhr, and the violent fluctuations of exchange rates which ensued, are momentarily checking the improving trend of the market and are imposing caution both on sellers and purchasers.

The blowing out of many blast furnaces in Lorraine and in the east of France, owing to the suspension of Ruhr coke shipments, is restricting the output of iron ore in those districts, let alone the interruption of ore shipments to Germany. Many French iron mines, worked by means of power obtained from exhaust gases from blast furnaces, were directly affected by the blowing out of the latter; some of the mines are even in danger of becoming filled with water from that cause.

So far, no change is being reported in the prices of French iron ores, but it is probable that they will soon be influenced by the rise of foreign ores.

Before the present events in the Ruhr a revival in copper business was noted everywhere in Europe, and it is probable that if the occupation of the German industrial district—which was imposed upon France and Belgium by Germany's systematic evasion of her obligations—continues some time longer without departing from its peaceful character, we might witness ere long a new upward start of the copper market.

In France, consumers are certainly well disposed; but the present instability of exchange rates causes them to restrict their purchases as much as possible and to rely on their stocks until these are completely exhausted.

It may be reckoned that the French consumption of copper is now at the rate of about 100,000 metric tons per annum, which will be considerably increased when the projected works of railway electrification, and other utilities, are carried out. On the other hand, stocks of copper are now practically non-existent in France (as is also the case for other metals), as the stocks still held by the French State are reserved for its military requirements.

Plans for the electrification of French railways are now being taken vigorously in hand. The program of railway electrification now contemplated amounts to 5,000,000,000 francs, over about twelve years. In 1912, about 1,500,000 hp. of hydraulic power was equipped in France. This figure has now been raised to 2,000,000 hp. and will be raised to 3,000.000 hp. within about two years, when 1,500,000 hp. will still remain to be equipped. Then, too, improvement of the French telephone system, involving an aggregate expense of over 2,000,000,000 francs, is now before the French Parliament. It concerns especially the creation of interurban lines for extensive traffic and of central telephonic offices working automatically.

An increase of production recently caused some weakness in zinc prices. But, owing to the probability of a decrease in Belgian production through the interruption of Ruhr coal shipments and owing also to the cessation of zinc shipments to France from Germany, the zinc market here may soon firm up again.

Imports of Ores and Metals in October, 1921 and 1922

Because of the enactment of the new tariff law, with the extensive changes in import duties, figures covering imports have been greatly delayed. The Bureau of Foreign and Domestic Commerce has just made public its compilation covering imports in October. Detailed figures covering certain metals and ores are as follows:

Imports

In Pounds, Unless Otherwise Stated

	October, 1921	October, 1922
Antimony		
Ore	.....	.....
Metal, matte and regulus	1,541,180	694,176
Copper and brass		
Ore	7,824,656	1,097,650
Concentrates	168,966	6,423,810
Regulus, coarse metal and cement copper	451,929	76,293
Total	8,445,551	7,597,753
Imported from:		
Spain	271,555	192,388
Canada	226,425	.....
Mexico	443,389	4,757,555
Cuba	.....	1,964,212
Chile	3,924,383	475,183
Colombia	.....	35
Peru	1,813,887	18,666
Other countries	1,765,912	189,714
Unrefined black, blister and converter copper in pigs and bars	23,360,893	20,981,156
Imported from:		
United Kingdom	1,012	92,996
Canada	9,842,963	3,230,807
Mexico	1,779,856	6,782,514
Chile	.....	4,292,246
Peru	8,890,191	6,582,468
Other countries	2,846,871	125
Refined copper	534,584	12,322,785
Old and clippings for remanufacture	203,141	776,512
Comp metal, copper chief value	23,400	223,162
Copper manufactures	.....	27,794
Brass		
Old and clippings for remanufacture	5,785,639	9,387,714
Manufactures of brass	.....	69,461
Lead		
Ore and matte	842,522	1,328,595
Bullion or base bullion	17,611,601	4,825,143
Pigs, bars, other forms, and old	1,969,660	356,023
Manufactures of lead (except type metal)	.....	19,775
Type metal (lead content)	.....	170,625
Manganese ore, long tons	36,760	480
Tungsten ore, long tons	54	.....
Pyrites, long tons	13,381	14,671
Tin		
Tin ore	38,926	659,827
Tin in bars, blocks and pigs	4,351,741	15,086,403
Imported from:		
United Kingdom	541,876	1,588,132
British Straits Settlements	3,663,882	9,694,791
Dutch East Indies	112,183	784,005
Hongkong	.....	2,532,124
Australia	33,600	152,320
Other countries	.....	335,031
Zinc ore	.....	.....
Zinc in blocks, pigs, etc	.....	4,533

Diamond Monopoly Extends Control

An agreement has been concluded by the De Beers interests, says *Commerce Reports*, whereby diamonds produced in the Kongo and in Portuguese West Africa will be disposed of in conjunction with the Diamond Syndicate, thereby re-establishing control of the disposition of the output of all the principal producers of diamonds and preventing price fluctuations. January sales, as reported by the syndicate, were the largest on record during the last three years.

Announcement has been made by De Beers that a satisfactory arangement has been entered into for the sale of an important quantity of diamonds for the next six months. In December, De Beers declared a dividend of 30 per cent, or 15s. a share, on preferred stock. Authority was obtained to purchase shares in the Premier mine at the rate of one De Beers deferred share for every two Premier deferred shares.

The New German Iron-Ore Contracts

Regarding the new contracts of the German metallurgical works in the Ruhr district with foreign iron-ore mines, the following data have been published in Europe:

Before the war the Rhenish-Westphalian metallurgical works received a part of the iron ore from Sweden, and had entered into contracts, some of which were to expire in 1927. On account of the changed conditions new arrangements were made, expiring on the first of May, 1923. As a result of the French occupation of the Ruhr district, the German concerns have cancelled their contracts with the Lorraine minette mines and renewed the Swedish contracts up to the year 1932. According to a report from Stockholm these new German-Swedish iron-ore contracts call for five million metric tons per year. By these contracts Germany has become the largest buyer of Swedish ores. The price has been fixed at 15.5 Swedish crowns per metric ton. The percentage of iron of the Swedish ores surpasses by far that of the Lorraine minette, so that the higher price for the Swedish ores is fully compensated by the higher quality. The above price remains in force until 1932.

Further ore supplies have been secured by the Germans in Spain and Spanish Morocco. The quality of these ores is said to be equal to that of the Algerian ores which up to some time ago were worked up in the Ruhr district. It is also stated that the Swedish and Moroccan ores have, in comparison with the Lorraine ore, the advantage of requiring less coke in the furnaces. The German works also received, up to the present time, Wabana ores from Canada, these mines being controlled by an English company. A trial contract was made last year calling for twelve months' deliveries. Negotiations for a further supply of Wabana ores have been postponed and will be taken up again as soon as conditions become more favorable.

Mining Dividends for February

The following dividends were paid by mining and metallurgical companies in February:

Companies in the United States	Situation	Per Share	Total
Chief Consolidated, s.l.	Utah	$0.10 Q	$88,403
Colorado Fuel & Iron, pfd.	Colo., N. M., Wyo.	2.00 Q	40,000
General Development Co.	U. S.	0.25 Q	30,000
Homestake Mining, g.	S. D.	0.50 M	125,580
International Nickel, pfd.	W. Va., Ont.	1.50 Q	133,689
Miami Copper	Ariz.	0.50 Q	373,557
New Cornelia Copper	Ariz.	0.25 Q	450,000
New Jersey Zinc	U. S.	2.00 Q	909,328
U. S. Steel pfd.	U. S.	1.75 Q	6,304,919
United Verde Ext., c.	Ariz.	0.50 Q	525,000
Companies in other countries			
Amparo Mining, g.s.	Jalisco	0.03 Q	60,000
Hollinger Consolidated, g.	Ont.	0.05 4 wks.	246,000
Rand Mines Ltd., g.	S. Africa	2.35 A	141,000

Q, quarterly; M, monthly; A, on 60,000 American shares; g, gold; s, silver; l, lead; c, copper.

February dividend disbursements were much the same as were paid three months ago, although no report has been received of any Lake Shore dividend after payments were made last August and November.

Expect Tennessee Copper Co. to Resume Dividends in March

Tennessee Copper & Chemical Corporation will probably resume dividend payments in March, at a rate of 25c. a quarter. Earnings after bond interest, but before depreciation, have been at a rate of $100,000 a month since October, when the change came in acid demand. With depreciation charged off, earnings are at rate of about $75,000 a month, or $900,000 a year. This is at the annual rate of $1.13 a share on the 794,226 shares outstanding.

Within the next few days copper production will have been increased to a rate of 1,000,000 lb. a month, compared with 700,000 lb. heretofore. This increased production will be obtained by putting about one-third the copper output through the converters as concentrate direct from the flotation plant without going through the blast furnaces.

MINING STOCKS

Week Ended Feb. 17, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	66	58	65½	Dec. '22, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2⅛	2⅛	2⅛		
Allouez	Boston	25	22	25	Mar. '19	1.00
Anaconda	New York	50⅜	48	50⅜	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3¼	3 1/16	3¼		
Ariz. Com'l	Boston	10⅛	8⅛	10⅛	Oct. '18, Q	0.50
Bingham Mines	Boston	18	17⅛	18	Sept. '19, Q	0.25
Calumet & Arizona	Boston	61½	55¼	61	Dec. '22, Q	0.50
Calumet & Hecla	Boston	315	295	315	Dec. '22, Q	5.00
Canada Copper	N. Y. Curb	*3	*2	*3		
Centennial	Boston	9⅛	8⅛	8⅛	Dec. '18, SA	1.00
Cerro de Pasco	New York	46½	43⅜	46½	Mar. '21, Q	0.50
Chile Copper	New York	30⅛	29	30		
Chino	New York	26⅜	25⅛	26⅛	Sept. '20, Q	0.37
Copper Range	Boston	41	37	40⅛	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅛	1 1/16	1 1/16		
Davis-Daly	Boston	3⅛	3	3⅛	Mar. '20, Q	0.25
East Butte	Boston	10⅛	8⅛	10⅛	Dec. '19, A	0.50
First National	Boston Curb	50	42	49	Feb. '19, SA	0.15
Franklin	Boston	2⅛	1⅞	2⅛		
Gadsden Copper	N. Y. Curb	*70	*70	*70		
Granby Consol.	New York	29⅛	25⅛	28⅛	May '19, Q	1.25
Greene-Cananea	New York	29	27	29	Nov. '20, Q	0.50
Hancock	Boston	3	2⅜	2⅛		
Howe Sound	N. Y. Curb	3¼	3	3¼	Jan '21, Q	0.05
Inspiration Consol.	New York	40⅛	34⅛	40	Oct. '20, Q	1.00
Iron Cap	Boston Curb	6½	5½	6½	Sept. '20, K	0.25
Isle Royale	Boston	28⅛	23⅛	28⅛	Dec. '22, K	0.50
Kennecott	New York	42⅜	38⅛	42	Jan. '23, K	0.75
Keweenaw	Boston	2	1⅛	1⅛		
Lake Copper	Boston	4	3⅛	3⅛		
Magma Copper	New York	34⅛	32	34⅛	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2⅛	1⅛	2⅛		
Mass Consolidated	Boston	2	2	2	Nov. '17, Q	1.00
Miami Copper	New York	29⅛	27⅛	29⅛	Feb. '23, Q	0.50
Michigan	Boston	3	2⅛	2⅛		
Mohawk	Boston	60⅛	54	60⅛	Nov. '22, Q	1.00
Mother Lode Coa.	New York	13⅛	11⅛	13⅛	Dec. '22, K	0.50
Nevada Consol.	New York	17⅛	15⅛	17	Sept. '20, Q	0.25
New Cornelia	Boston	19⅛	18⅛	19⅛	Nov. '22, Q	0.25
North Butte	Boston	10⅛	9⅛	10⅛	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*51	*46	*51		
Old Dominion	Boston	25⅛	21	25⅛	Dec. '18, Q	1.00
Osceola	Boston	36⅛	31⅛	36⅛	Dec. '22, K	1.00
Phelps Dodge	Open Mar.	†175	†165		Jan. '23, Q	1.00
Quincy	Boston	42⅛	35⅛	42⅛	Mar. '20, Q	1.00
Ray Consolidated	New York	15⅛	14⅛	15⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅛	1	1⅛		
St. Mary's Min. Ld.	Boston	45	41	45	Apr. '22, K	2.00
Seneca Copper	Boston	12	11	12		
Shannon	Boston	*90	*60	*90	Nov. '17, Q	0.25
Shattuck Arizona	New York	10	9	10	Jan. '20, Q	0.25
South Lake	Boston	†*75	†*50	*50		
Superior & Boston	Boston	3⅛	3	3⅛		
Tenn. C. & C. cfs.	New York	12⅜	11⅛	12⅜	May '18, I	1.00
Tuolumne	Boston	*65	*62	*63	May '13,	0.10
United Verde Ex.	N. Y. Curb	29	27⅛	29	Nov. '22, Q	0.25
Utah Consol.	Boston	1⅛	1 1/16	1⅛	Sept '18,	0.25
Utah Copper	New York	70	65⅛	70	Dec. '22, Q	0.50
Utah Metal & T.	Boston	1⅛	*96	1⅛	Dec. '17,	0.30
Victoria	Boston	1⅛	1⅛	1⅛		
Winona	Boston	1⅛	1	1		
Wolverine	Boston	9	8⅛	8⅛		
NICKEL-COPPER						
Internat. Nickel	New York	16⅛	14⅜	16⅛	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	78⅛	77	78⅛	Feb. '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	6	5⅛	6		
National Lead	New York	133⅛	130⅛	131⅛	Dec. '22, Q	2.00
National Lead, pfd.	New York	114	114	114	Dec. '22, Q,	1.75
St. Joseph Lead	New York	20	19⅛	20	Dec. '22, Q, X	0.50
ZINC						
Am. Z. L. & S.	New York	19⅛	16⅛	18⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	56⅛	54⅛	55⅛	Nov. '20, Q	1.50
Butte C. & Z.	New York	11⅞	10⅜	11⅛	June '18,	0.50
Butte & Superior	New York	34⅛	31⅛	33⅛	Dec. '22,	0.50
Callahan Zn-Ld	New York	12	10⅛	12	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	171⅛	170	171	Feb. '23, Q	2.00
Yellow Pine	Los Angeles	...	...	*77	Sept. '20, Q	0.03
SILVER						
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	38⅛	32⅛	38⅛	May '20, K	0.03
Candelaria	N. Y. Curb	*33	*30	*31		
Coniagas	Toronto	2.15	2.15	2.15	May '21, Q	0.12½
Crown Reserve	Toronto	*36	*35½	*36	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	1⅛	1 1/16	1⅛		
Kerr Lake	N. Y. Curb	3⅛	3	3⅛	Jan. '23, Q	0.12½
La Rose	Toronto	*37½	*34	*36	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*22	*18	*19½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.45	1.30	1.30	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅛	5⅛	6	Jan. '23, Q, X	0 60
Ontario Silver	New York	...	...	5	Jan. '19, Q	0.50
Temiskaming	Toronto	*35	*32	*34	Jan. '20, K	0.04
Trethewey	Toronto	*5	*4	*4	Jan. '19,	0.05

Stock	Exch.	High	Low	Last		Last Div
GOLD						
Alaska Gold	New York	¼	¼	¼		
Alaska Juneau	New York	1⅛	1	1		
Atlas	Toronto	13½	12¼	13		
Carson Hill	Boston	9⅛	8	8		
Cresson Consol. G.	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '23 Q.	0.10
Dome Mines	New York	42⅛	39⅛	41⅛	Jan. '23, Q	0.50
Golden Cycle	Colo. Springs	*92½	*92	*92½	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	14.40	13.30	13.30	Jan. '23, M	0.05
Homestake Mining	New York	73½	73½	73½	Jan '23, M	0.50
Keora	Toronto	*9½	*9	*9		
Kirkland Lake	Toronto	*48½	*43½	*48		
Lake Shore	Toronto	3.50	3.44	3.49	Nov. '22, Q	0.02
McIntyre- Porcupine	Toronto	20.00	19.40	19.40	Jan. '23, K	0.25
Porcupine Crown	Toronto	15⅛	12	15¼	July '17,	0.03
Portland	Colo. Springs	†*50	†*33	*40	Oct. '20, Q	0.01
Schumacher	Toronto	*30	*30	*30		
Teck Hughes	Toronto	*96	*93	*93		
Tom Reed	Los Angeles	1.27	1.07	1.21	Dec. '19,	0.02
United Eastern	N. Y. Curb	2 1/16	2 1/16	2 1/16	Jan. '23, Q	0.15
Vipond Cons.	Toronto	*78½	*74	*78½		
White Caps Mining	N. Y. Curb	*7	*6	*6		
Wright-Hargreaves	Toronto	3.38	3.29	3.38	Jan. '23,	0.02½
Yukon Gold	N. Y. Curb	*76	*76	*76	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*11	*10	*10		
Cons. Virginia	San Francisco	10⅛	10⅛	*10⅛		
Continental Mines	N. Y. Curb	5	4	4⅛		
Dolores Esperanza	N. Y. Curb	1⅞	1⅞	1⅞	Jan. '23	2.50
Tonopah Belmont	N. Y. Curb	1 1/16	1 1/16	1 1/16	Jan. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*70	*67	*67		
Tonopah Extension	N. Y. Curb	3⅛	3 1/16	3⅛	Jan. '23, Q	0.05
Tonopah Mining	N. Y. Curb	2⅛	2 1/16	2⅛	Jan. '23, SA,	0.15
West End Consol.	N. Y. Curb	1 1/16	1 1/16	1 1/16	Dec. '22, Q	0.05
SILVER-LEAD						
Caledonia Mng	N. Y. Curb	*10	*9	*9	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*32	*31	*31	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅞	4⅜	4⅜	Feb. '23, Q	0.10
Columbus Rexall	Salt Lake	*21	*20	*21	Aug. '22,	0.03
Consol. M. & S.	Montreal	28½	26½	28	Oct. '20, Q	0.62½
Eagle & Blue Bell	Boston Curb	†3	†2	3	Nov. '22, K	0.05
Federal M. & S.	New York	12⅛	10⅛	11⅛	Jan. '09,	1.50
Federal M. & S. pfd.	New York	60⅛	51	53⅛	Dec. '22, Q	1.25
Florence Silver	Spokane	*38	*38	*38	Apr. '19,	0.01½
Hecla Mining	N. Y. Curb	9⅛	8⅛	9⅛	Dec. '22, Q, X	0.50
Iron Blossom Con.	N. Y. Curb	*31	*31	*31	Apr. '22, Q	0.02½
Mars'h Mines	N. Y. Curb	*8	*7	*7	June '21, I	0.02
Park City	Salt Lake	3.40	3.40	3.40	Jan. '23,	0.10
Prince Consol.	Salt Lake	*11⅛	*9⅛	*11	Nov. '17,	0.02½
Silversmith	Spokane	*45	*40	*41	Oct. '22,	0.01
Simon Silver Lead	N. Y. Curb	*35	*31	*35		
Tamarack-Custer	Spokane	1⅛	1⅛	1⅛	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.70	2.60	2.70	Dec. '22, Q, X	0.10
Utah Apex	Boston	4	3⅞	4	Nov. '20, K	0.25
IRON						
Bethlehem Steel "B"	New York	67⅛	65⅛	66⅛	Jan. '23	0.25
Char. Iron	Detroit	...	...	1⅛		
Char. Iron, pfd	Detroit	...	...	2⅛		
Colorado Fuel & Iron	New York	31⅛	29⅛	31	May '21	0.75
Col. Fuel & Iron, pfd.	New York	...	...	105	Nov. '22	2.00
Gt. North'n Iron Ore	New York	35⅛	31⅛	34	Dec. '22	1.00
Inland Steel	N. Y. Curb	...	...	47	Dec. '22	0.25
Mesabi Iron	N. Y. Curb	10⅛	10⅛	10⅛		
Replogle Steel	New York	31⅛	28⅛	31⅛		
Republic I. & S.	New York	59⅛	56⅛	57⅛	May '21	1.50
Republic I. S., pfd.	New York	93⅛	92⅛	93⅛	Jan. '22	1.75
Sloss-Sheffield S. & I.	New York	52	49⅛	50⅛	Feb. '21	1.50
U. S. Steel	New York	108⅛	106⅛	107⅛	Dec. '22	1.25
U. S. Steel, pfd.	New York	120⅛	120⅛	120⅛	Feb. '23	1.75
Virginia I. C. & C.	New York	55⅛	54⅛	55⅛	Jan. '22	1.50
Virginia I.C.&C., pfd.	New York	...	...	80	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	44	39	44	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	70	67⅛	69	Oct. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	87	86	87	Oct. '22, Q	1.75
SULPHUR						
Freeport Texas	New York	21⅛	19⅞	20⅛	Nov. '19, Q	1.00
Texas Gulf	New York	62	60⅛	61⅛	Dec. '22, Q X	2.00
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	54⅛	52⅛	52⅛	Dec. '22, Q	0.75
Amer. Metal pfd.	New York	117	117	117	Dec. '22, Q	1.75
Amer. Sm. & Ref.	New York	64⅛	61⅛	64⅛	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	101⅛	100⅛	101⅛	Dec. '22 Q	1.75
U. S. Sm. R. & M.	New York	41⅛	36⅛	40	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	46	45⅛	46	Jan. '23 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

A Safety Cupola Tapper and Stopper

Every foundryman and furnaceman knows that the governing of the flow of molten metal from a cupola is an exacting job. An apparatus that removes the hazards from cupola tending and prevents the serious accidents which sometimes occur has been invented and placed on the market by the Medart Co., St. Louis, Mo.

A special composition ball (with a bolt head hole in the center) fits against the breast of the cupola when the flow is stopped. The ball is bolted to a cup which is threaded onto a piston rod. This piston rod is threaded into a piston which moves backward and forward into a sleeve and frame. The piston is attached with a pin and link at the rear to a lever shaft, which carries the lever from which the apparatus is actuated. On the lever shaft is mounted a counterweight.

Extensions may be added to the lever as desired, so that the operator may be stationed at whatever point is convenient in each foundry, at any distance in front or at the side of the cupola, as may be desirable.

As the lever is shoved forward or backward, the ball is moved out of or into the cupola breast to tap and stop the flow, as desired, and is held rigidly in either position by a counterweight. A chained pin also may be used to lock the ball out of the breast, as when the breast is being built.

The sleeve and frame is supported on rests which fit into the two hinge lugs turning on a hinge rod in two bracket lugs, which are bolted or riveted to one side of the cupola spout.

On the opposite side the frame sets on the spout and on the rest lug, which is bolted or riveted to the left-hand side of the spout. Adjustment of the ball up and down to insure a nice fit in the breast may be secured by means of a set screw.

Except for the composition ball, there are no parts of this tapper and stopper which are subjected to any appreciable wear. Barring accidents, the mechanism can be expected to remain in service almost endlessly.

The composition ball usually should be renewed after each four to six heats. The cost of this ball is negligible (the price being but 75c.), so there is practically no expense of operation.

An Example of Belt-Conveyor Service

Unusual service on the part of a belt conveyor was disclosed some months ago when a fire broke out in the coal-handling division of the Inland Steel Co.'s coke plant at Indiana Harbor, Ind. This fire completely destroyed the 300-ft. inclined belt conveyor and gallery which formerly handled the coal from the crusher house to the mixer house.

The installation of belt conveyors was made by the Link-Belt Co., of Chicago, in 1913, and at the time there was considerable discussion regarding the probable durability of the material that was offered for the work. To overcome this doubt it was necessary for the Link-Belt people to guarantee a handling capacity of 1,500,000 tons of coal for each belt. In the nine years that intervened, however, each belt handled approximately 3,500,000 tons, and from reports, all of the belts were in fair condition at the time of the fire.

The damage is being repaired. The Link-Belt Co. has been awarded a blanket order to rebuild the conveyors, and the Morava Construction Co. is to rebuild the structural work.

INDUSTRIAL NOTES

The explosive known as Monobel No. 8 has passed all tests, including the low freezing test of the U. S. Bureau of Mines, necessary to place it on the list of permissible explosives for use in coal mines. It is now entitled to the official L. F. designation and will hereafter be branded as Monobel No. 8 L. F. Monobel No. 8 has now received the highest rating given to an explosive, indicating its suitability for use in gaseous and dusty mines. This explosive is one of the slowest strong permissibles made by the E. I. du Pont de Nemours Co.

TRADE CATALOGS

Paint Spraying Equipment—The International Engineering Corporation, Malden, Mass., has issued literature outlining the practice and principles of "International" paint guns and painting machines. These devices will have a wide application in work about mines, mills, smelters, and refineries.

Pulverized Coal Systems—The Bonnot Co., Canton, Ohio, has issued bulletin No. 60, which describes the Holbeck pulverized-coal systems for which this company is the sole licensee in this country. Illustrations and diagrams, together with a list of the advantages claimed, are also given.

Sand Tanks—The Allen Cone Co., El Paso, Texas, has issued bulletin No. 23, which describes in detail the Allen sand tank. The distinguishing feature of this device is the automatic float control which is operated to govern the opening of the discharge valve by the depth or volume of the sand in the tank, instead of by the weight of the sand, as most sand separators are controlled.

Economizers—The Power Specialty Co., 111 Broadway, New York, has just issued Bulletin EC 100, which outlines the development in economizer practice and gives a detailed description of the construction of the pressure parts and housing of the Foster economizer and its simplicity of operation. There are also included illustrations of typical arrangements permitted by the compactness of this apparatus and test data showing the performance of a few of the economizers in service.

Gas Producer Plants—The Western Machinery Co., Ltd., Perth, Western Australia, includes in an 18-page catalog which lists gas engines, water coolers, pumps, and like equipment, a description of the Commonwealth downdraft gas producer plants for burning wood fuel. In Australia the Commonwealth producer is said to have revolutionized power costs, and by using wood as fuel in the generator, in place of charcoal or coal, fuel costs have been reduced at least 50 per cent.

Belt Conveyor Idlers—The Chillingworth Engineering Corporation, 143 Liberty St., New York, has recently issued Bulletin No. 3, descriptive of Mellin belt conveyor idlers. Among the advantages claimed for this type are: perfect trough, minimum weight of rotating parts, correct lubrication, low frictional resistance, great strength, automatic alignment, simplicity, interchangeability and small number of parts. The pulleys are of seamless cold-drawn steel tubing with pressed-steel ends welded to tubing in which shafts are fixed.

Flotation Machines—The Simplex Machine Co., 1260 Fifth St., Denver, Colo., has recently issued a descriptive booklet, "The Simplex Flotation Machine," which illustrates and details this emulsifier and aerator. The machine is built of simple parts, there being no new and untried principle involved. The revolving blades of wire screen disperse the oil completely, thereby producing a thorough emulsion with the water, and at the same time "beat the air in," causing a voluminous ascending froth in the froth cell by this pneumatic action.

Lifting Magnets — Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has just issued an illustrated 24-page booklet on lifting magnets. The features of the "Red" magnets are fully illustrated and described—such as the heavy outer pole shoe of massive flange construction and the protected pockets for bolt head in both the inner and outer pole shoes. The appearance of the "Red" magnet is considerably different and the painting of the body with a red-orange paint is distinctive. The magnets are made in the following sizes: 39 in., 45 in., 55 in. and 65 in., although 18-in. and 24-in. magnets are still included in the line. Special mention is made of the method of control and the C-H magnetic controller and master switch furnished with Cutler-Hammer magnets, and the numerous illustrations, give evidence of the many and various applications of lifting magnets today.